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Draft
ENVIRONMENTAL IMPACT STATEMENT

on the
Proposed Kootenai River Hydroelectric Project
at
Kootenai Falls

Addendum to the Federal Energy Regulatory Commission
Final Environmental Impact Statement

July, 1982

MONTANA DEPARTMENT OF NATURAL
RESOURCES & CONSERVATION
ENERGY DIVISION
DNRC

ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
af	acre feet
BPA	Bonneville Power Administration
BNRR	Burlington Northern Railroad
cfs	cubic feet per second
DCA	Montana Department of Community Affairs
DFWP	Montana Department of Fish, Wildlife, and Parks
DHES	Montana Department of Health and Environmental Sciences
DLI	Montana Department of Labor and Industry
DNRC	Montana Department of Natural Resources and Conservation
DOE	U.S. Department of Energy
DSL	Montana Department of State Lands
EIS	environmental impact statement
FERC	Federal Energy Regulatory Commission
ft	foot or feet
in	inch or inches
kVA	kilovoltampere
kW	kilowatt
kWh	kilowatt hour
MEPA	Montana Environmental Policy Act
MFSA	Montana Major Facility Siting Act
mi	mile or miles
msl	above mean sea level
MW	megawatt
NEPA	National Environmental Policy Act
NLI	Northern Lights Incorporated
PNUCC	Pacific Northwest Utilities Conference Committee
PRS	Power Requirements Study
PURPA	Public Utility Regulatory Policy Act
SHPO	State Historic Preservation Office
USCE	U.S. Army Corps of Engineers
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WAI	Western Analysis Incorporated
WMED	Western Montana Energy Developers
WMEG&T	Western Montana Electric Generation and Transmission
WPPSS	Washington Public Power Supply System

SUMMARY OF DNRC'S DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE PROPOSED KOOTENAI RIVER HYDROELECTRIC PROJECT AT KOOTENAI FALLS

The Applicant's Proposal

Northern Lights, Incorporated (NLI), a rural electric cooperative, has applied to the Montana Department of Natural Resources and Conservation (DNRC) for a Montana Major Facility Siting Act (MFSA) certificate to allow construction of a hydroelectric facility at the crest of Kootenai Falls on the Kootenai River between Libby and Troy. Under the terms of MFSA the certificate can be issued only if the applicant can demonstrate environmental compatibility and public need for the facility. In making this application, NLI was acting on behalf of itself and seven other partners as the Western Montana Energy Developers (WMED), including the Ravalli County Electric Cooperative Inc., Vigilante Electric Cooperative Inc., Missoula Electric Cooperative Inc., Flathead Electric Cooperative Inc., Glacier Electric Cooperative, Inc.; Lincoln Electric Cooperative, Inc.; and the Flathead Irrigation and Power Project (under the jurisdiction of the Bureau of Indian Affairs). These cooperatives serve rural customers over most of western Montana.

The proposed dam would be 925 ft long and about 30 ft high, with six hydraulically operated steel gates 12 ft high and 127 ft 6 in long arranged side by side across the top. These gates would be raised or lowered to stabilize the surface elevation of the reservoir between 1,999 and 2,000 ft above mean sea level. The length of the reservoir at any given time would depend on river flow at the time, with a maximum length of 4.5 mi and a maximum surface area of 232 acres. The dam could generate up to 144 megawatts (MW) but would produce an average of 58.8 MW under normal flow variations.

The dam would be the only above-ground part of the generating facility. The powerhouse and all associated developments except for several tunnel entrances would be underground. The water used for generation would be returned to the river channel about .8 mi downstream from the dam. A flow of at least 750 cubic feet per second (cfs) would be released over the dam and falls at all times, contrasted to the present annual average flow of 13,000 cfs.

Setting of the Proposed Project

The proposed dam site at Kootenai Falls is on the Kootenai River about 26 mi downstream from Libby Dam and 9 mi downstream from the town of Libby. The Kootenai valley at the falls is narrow and enclosed by high, tree-covered mountains. Kootenai Falls is not a single vertical drop, but has a main drop about 30 feet high and a series of lesser drops, cataracts and rapids, which add up to a total 90 ft drop in the .8 mi of river beginning at the falls. Kootenai Falls is the last undeveloped waterfall on a major river (average flow of 4,000 cfs or more) in the four-state region of the Northwest.

The character of the falls varies greatly according to the amount of water in the river. Flows are controlled by the discharges from Libby Dam, which vary in a normal year from 4,000 cfs to about 40,000 cfs. The flows at the falls sometimes change greatly in a single day, with water levels allowed to rise up to 2 ft an hour, and up to 6 ft in a single day in the winter, and 4 ft a day in the summer.

The portion of the river that would be impounded by the proposed dam is classified as a blue ribbon fishery, and is as popular with fishermen as some of Montana's most famous trout streams. The north shore in the project area is home to the Kootenai Falls bighorn sheep herd, and harlequin ducks, (rare in Montana) are found at the falls.

There are 37 archaeological and historical sites within the project boundaries. Most of these sites are prehistoric campsites that were used by river travelers, including the Kutěnai Indians and perhaps their predecessors, and later, white traders, who were forced by the falls to portage over a rocky trail past the falls on the north canyon wall.

The falls and the river 3 mi upstream and downstream is held sacred by the Kutenai Indians, who believe the falls is inhabited by their creator. They say also that the river downstream is important to their subsistence foraging for traditional foods.

The social environment in Lincoln County is dominated by high unemployment (16 percent in January, 1982, 37 percent in March). The high unemployment is one of the major reasons many residents support construction of the dam. The urge on one hand to develop employment opportunities and on the other hand to maintain a healthful environment has led to social conflict, with the local population highly vocal and about equally divided as to whether the dam should be built.

The major adverse and favorable effects of the project area as follows:

Summary of Major Effects

Economic Benefits	Provision of a maximum of 500 temporary construction jobs lasting up to 2 years. About 180 of those jobs are expected to go to Lincoln County residents, depending on hiring policies. There would be 20 permanent jobs operating the project. The dam would add $6.7 million to the Troy School District's taxable value. The long term benefits to the county would be small, amounting to about 1 percent of the total county revenues at the 1979 level.
Consumers' Cost of Power	Provision of an average 58.8 MW of of electricity at a price slightly lower than it could be provided by BPA over the estimated 50 yr life of the project. The cheaper power from the dam would reduce the average monthly power bill in the WMED service area in 1994 by $1 below what it would be if all the power were furnished by BPA.
Fishery	Decline in high quality fishery through decreased movement of fish and aquatic invertebrates downstream, reduced water velocity and sedimentation, the prevention of upstream movement of fish, turbine mortality to fish, loss of the falls as a source of oxygen to reduce deficiency caused by Libby Dam, replacement of "blue ribbon" trout stream with reservoir fish habitat.
Wildlife	Decline of wildlife and habitat diversity, through loss of riparian vegetation, loss of the harlequin duck population, probable losses to mountain sheep from effects on the Corps replacement habitat.
Recreation and Aesthetics	Loss of recreation and aesthetic resources through inundation of China Rapids, dewatering of falls and canyon, placement of a concrete and steel structure in an otherwise natural scene, decline in fishing, loss of opportunity to view harlequin ducks and possible decrease in opportunties to see mountain sheep.
Unique Ecosystems	Loss of the last undeveloped waterfall on a major river in the Northwest.
History and Archaeology	Cumulative loss through construction, inundation, vandalism, and theft (impacts of Libby Dam and the proposed Kootenai Falls and reregulating dams) of historical and archaeological materials that could be essential to defining the history and prehistory of the Kootenai valley.
Water Quality	Loss of water oxygenation provided by the falls, causing a reduction in some species of aquatic organisms important as trout food below the falls.
Kutenai Indians	Loss of sacred area, and of sources of food that have cultural or religious significance.
Visitor Safety	Safety hazard from wadeability of the partially dewatered reach, combined with the possible malfunction in the powerhouse (predicted to happen once a year) leading to sudden major increases in water level in the dewatered area.
Highway Travel	Possible substantial traffic delays on Highway 2 in the vicinity of the project during construction, depending on the method of construction. Use of the highway as a haul road for excavated rock and construction materials would result in heavy trucks turning on to the road as often as every 5 minutes, resulting in a 15 mile-an-hour speed limit in the .9 mi portion of the highway used for hauling, and reduced speeds for a considerable distance approaching this segment.

Alternatives to the Proposed Action

DNRC examined numerous possible alternative sources to determine if WMED's loads could be met with power from sources other than the proposed project, including the continued purchase of all electricity from BPA as at present. Other sources examined were nuclear generation, coal-fired projects, including purchase of a share of Colstrip 3 and 4, wood-fired facilities, conservation in the industrial, commerical, residential, and irrigation sectors, solar systems, groundwater heat pumps, wood-burning stoves, installation of generators on existing small dams, construction of dams on the Kootenai River at sites other than the falls, and small-scale hydro development.

The research indicated that the only electricity that could be provided cheapter than from the dam over the long run was from conservation measures applied to existing houses and the installation of generators at three existing dams. These dams, Painted Rocks, Clark Canyon and Broadwater (Toston), were the only ones for which there was enough information to determine the amount and cost of power, although approximately 660 dams in Montana might be suitable for such installations.

It was found that the three dams could produce 10.3 average MW, with another 3.8 MW available through savings in residential conservation. Power from Colstrip, if available, would cost slightly more over the long run than power from the proposed dam, as would power from BPA.

Analyses of Future Energy Demand

DNRC estimated that WMED's load would be 189 MW in 1994 and 203 MW in 1998, compared to WMED's own estimate of 174 MW in 1994 and 324 in 1998. The WMED load for 1981 was 116 MW. The difference in the estimates by DNRC and WMED stem largely from differing estimates of population growth in the WMED service area.

At present, WMED gets all its power from BPA. At the time NLI applied for the project, it appeared BPA would cut off its supply to the cooperatives, but subsequent passage in Congress of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 made this unlikely. The 58.8 MW from the proposed project would not meet WMED's total load, no matter how slow the load growth, so all power in excess of 58.8 MW would have to be provided by BPA at a slightly higher cost, unless power from the dam retrofits or other sources not currently known were to become available. One of WMED's goals is to develop a secure source of power.

DNRC's cost-benefit analysis of the five supply options for WMED ranked the options in order of monetary benefit to Montana during the estimated 50-year period the proposed project could be operating. The ranking from greatest to least monetary benefit is: (1) construction of the proposed project along with retrofitting (installation of generators) at three existing dams and the implementation of residential energy conservation measures; (2) construction of the proposed project by itself; (3) purchase of a share of Colstrip units 3 and 4; (4) (same as (1) above but without the proposed project; and (5) purchasing all power from BPA.

Monetary benefits must be weighed against the environmental costs associated with each of the five supply options. These costs can change the ranking of the options. Some of these costs can be assigned dollar values but others cannot. The costs that cannot be assigned dollar values are often the most important in determining whether a given supply option would provide a net benefit or net cost to Montana.

DNRC concluded that no significant environmental costs would result from purchase of a share of Colstrip, purchase of BPA power, or the retrofit of existing dams and residential conservation. Construction of the proposed dam would cause a monetary loss through the adverse effects on current recreational opportunities at the falls. Other significant environmental costs from the proposed project include adverse impacts to: fisheries; bighorn sheep habitat; aesthetics; archaeological and historical sites; and the religious freedom of the Kutenai Indians.

The cost-benefit analysis does not resolve the question of which supply option has the greatest overall net benefit to Montana. The final determination as to the values to be assigned to the nonmonetary environmental costs must be made by the Board of Natural Resources.

DNRC's draft EIS on the proposed project considers all the issues, and leaves the conclusions to the judgment of the public and interested parties. After the end of the period designated for accepting response to the draft EIS, DNRC will evaluate the comments received, and on the basis of the information in the draft EIS and any important new material provided in comments, or obtained from elsewhere, will publish a final EIS culminating in DNRC's recommendations to the Board of Natural Resources and Conservation for its decision.

After reviewing all pertinent material, the Board must choose one of three options:

1) approve the project as proposed;

2) approve the project as applied for with whatever conditions may be necessary to avoid or reduce environmental impacts;

3) reject the project on the grounds that it cannot meet the need for electricity with the least environmental impact.

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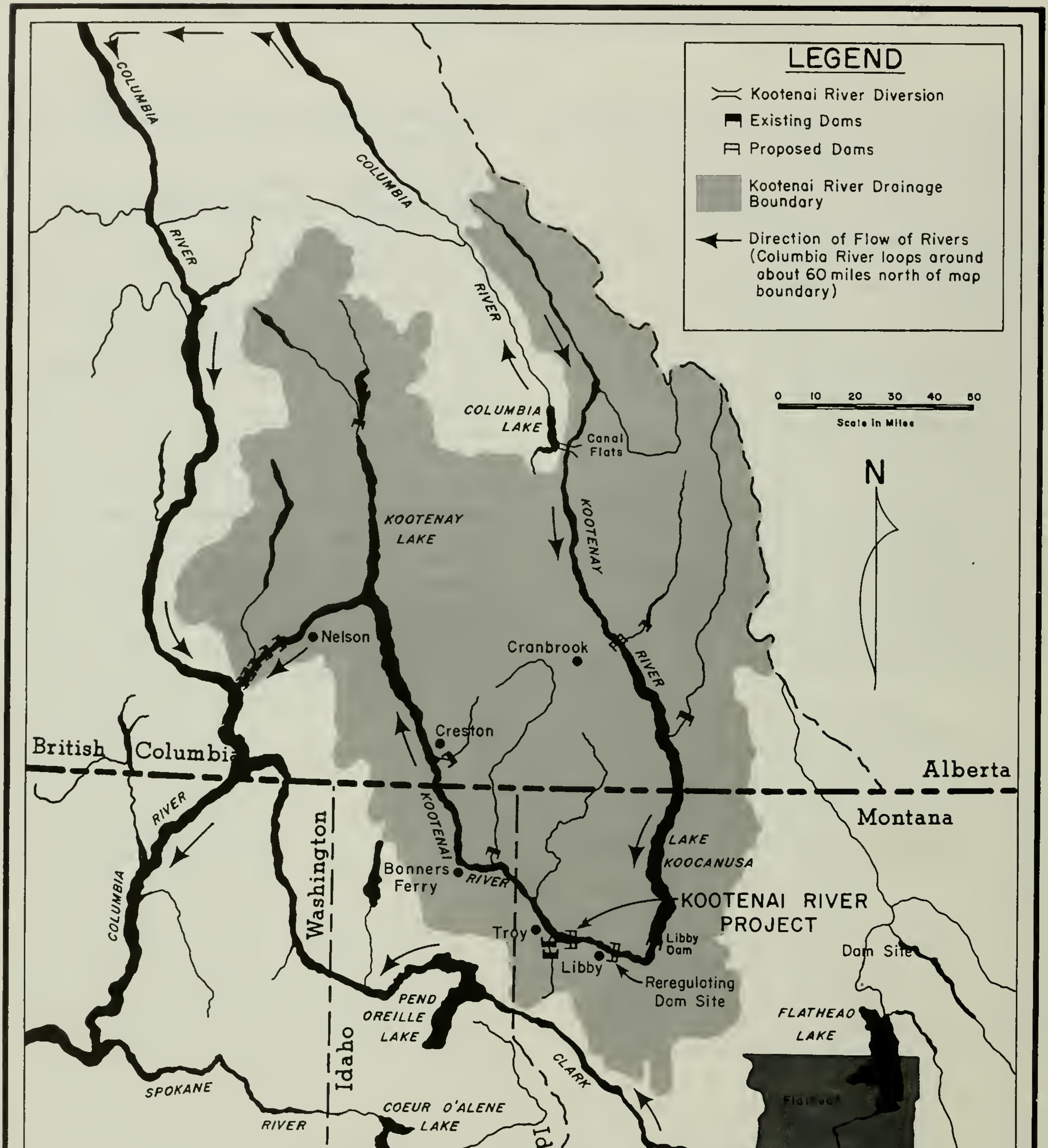


FIGURE 1-1. KOOTENAI RIVER BASIN

Source: DNRC

CHAPTER ONE - INTRODUCTION

This draft environmental impact statement (EIS) addresses the proposed Kootenai River Hydroelectric Project in Lincoln County, Montana (figure 1-1). The proposed project includes a 925-ft-long, approximately 30-ft-high concrete and steel dam that would span the Kootenai River at the crest of Kootenai Falls, and a system of tunnels associated with an underground powerhouse. The dam would be designed to produce up to 144 megawatts (MW) of electricity with an average generating capacity of 58.8 MW. The facility would be owned by the Western Montana Energy Developers (WMED) a consortium including Ravalli County Electric Cooperative, Inc.; Vigilante Electric Cooperative, Inc.; Missoula Electric Cooperative, Inc.; Flathead Electric Cooperative, Inc.; Glacier Electric Cooperative, Inc.; Lincoln Electric Cooperative, Inc.; Northern Lights Inc. (NLI); and the Flathead Irrigation and Power Project (under the jurisdiction of the Bureau of Indian Affairs). The service area of the WMED is shown in figure 1-2.

Should the project be constructed, NLI would own shares totaling 26.5 percent of the facility; and entitling it to a like share of the output. Each of the other members of WMED would own 10.5 percent. NLI is responsible for the construction and operation of the proposed facility and is referred to in this EIS as "the applicant."

NLI proposed to build the dam over a 5-year period beginning in June, 1984. The construction work force would peak at approximately 500 workers during the second year of construction. The applicant estimated the total cost of the facility (excluding interest during construction) to be $225.4 million (1981 dollars).

STATE ACTION ON THE PROPOSED PROJECT

In April, 1981, NLI filed a joint application under the Montana Major Facility Siting Act (MFSA) with the Department of Natural Resources and Conservation (DNRC) and the Department of Health and Environmental Sciences (DHES). Both departments accepted the application as complete in May, 1981.

MFSA provides comprehensive review of proposals to construct and operate certain kinds of facilities for generating, converting, or transmitting energy in Montana. Facilities capable of generating 50 MW of electricity or more, such as the Kootenai River Hydroelectric Project, fall within the authority of the act. MFSA requires that the Board of Natural Resources and Conservation must certify public need for and environmental compatibility of proposed facilities before construction can be approved. The Board of Health and Environmental Sciences retains the authority to require permits to build or operate portions of the project with possible effects on air or water quality.

Board of Health and Environmental Sciences Requirements

Within one year after it accepts an application, DHES is required to issue a decision as to whether the proposed project would comply with all applicable laws it administers. The feasibility of complying with all permit requirements and standards under DHES's jurisdiction must be determined for the primary and reasonable alternate locations for the proposed facility.

For the Kootenai Falls project, NLI must secure three permits (see table 1-1) from DHES: (1) Air Quality Permit, (2) Montana Pollutant Discharge Elimination System Permit, and (3) authorization to temporarily exceed turbidity standards during construction. NLI applied for each of these and a hearing to gather public opinion was held December 1, 1981.

Board of Natural Resources and Conservation Requirements

MFSA requires the Board of Natural Resources and Conservation to determine whether a proposed project is needed and is properly designed and located to cause only the minimum adverse impacts. Staff members of DNRC and DHES evaluate each proposal and compile a report for the Board of Natural Resources and Conservation. In the case of the Kootenai Falls project, part of this report is in the form of an EIS. After submission of the report, the Board of Natural Resources and Conservation hearings process begins with the appointment of a hearing examiner. Before the Board can approve the proposal, it must determine (1) that the facility is needed, (2) the nature of the probable environmental impacts and (3) that the facility represents the minimum adverse environmental impacts considering the state of available technology and the nature and economics of the various alternatives, (4) that the facility will serve the public interest, convenience and necessity, and (5) that the Department of Health and Environmental Sciences has issued any permits required within its jurisdiction.

FEDERAL ACTION ON THE PROPOSED PROJECT

On February 24, 1975, NLI applied to the Federal Energy Regulatory Commission (FERC) for a preliminary permit for possible hydropower development of the Kootenai Falls site. A preliminary permit secures and maintains the applicant's priority for a site while the applicant studies the feasibility of constructing a hydroelectric facility there. FERC granted NLI a preliminary permit on December 16, 1975.

On November 30, 1978, NLI applied to FERC for a license to construct and operate the Kootenai River Hydroelectric Project at Kootenai Falls. FERC accepted that application and began its environmental review and evaluation, which led to the publication of FERC's final environmental impact statement in April, 1981. FERC is now preparing to hold administrative hearings on the project, beginning in August, 1982, in Washington, D.C.

NLI is required to secure three federal permits for the proposed project: (1) a license from FERC, (2) a Special Use Permit from the Forest Service, and (3) a dredge and fill (404) Permit from the U.S. Army Corps of Engineers.

DNRC APPROACH TO EIS PREPARATION

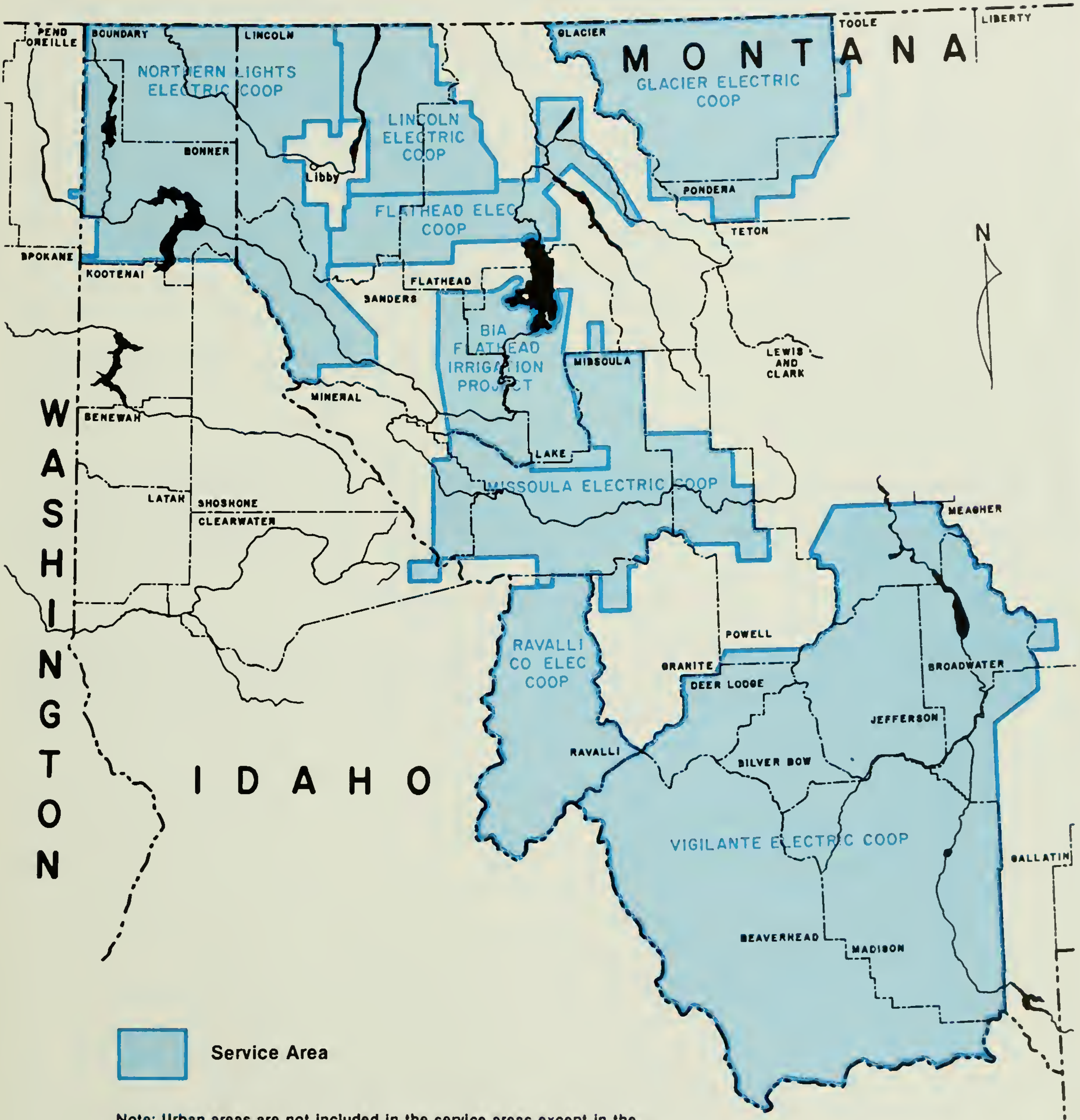
This draft EIS is an interdisciplinary document prepared in cooperation with state, federal and local government agencies. It explores alternatives to the proposed action, examines the need for the facility, and describes the environmental, social, and economic effects of the proposed project. The major issues and concerns studied, analyzed and reported here were identified in a series of interagency and public meetings held in Helena, Polson, Missoula, Kalispell and Libby in the summer of 1980. The work plans developed to investigate the impacts of the proposed project on social, economic and environmental elements identified in these meetings were prepared by DNRC staff and reviewed by cooperating agencies and authorities in each field. Staff working papers containing detailed descriptions of data and literature collected, research methods used, and analyses completed, were prepared for each resource area. The findings of these studies were summarized for this EIS. The complete working papers are on file at the Montana Department of Natural Resources and Conservation, Energy Division, 32 South Ewing, Helena, Montana 59620, (406) 449-4600.

In compliance with the Montana Environmental Policy Act (MEPA) (75-1-101 et seq. MCA), DNRC's EIS summarizes, corrects, and updates the FERC EIS on the Kootenai River Hydroelectric Project (FERC 1981). DNRC agrees with much of the information presented in the FERC EIS, but concluded that various shortcomings (such as FERC's analysis of the need for the facility) made the FERC document insufficient to comply with MFSA. Some of the FERC information was not presented in sufficient detail (such as alternatives to the proposed project) while other important issues were not discussed at all (such as cost-benefit analysis). FERC's EIS was prepared under the requirements of the National Environmental Policy Act (NEPA), which was designed to explore the environmental consequences of governmental actions such as approval or rejection of applications for projects.

The Montana Environmental Policy Act requires preparation of an EIS on any major state action that may significantly affect the quality of the human environment. The Board's decision on whether to grant the MFSA certificate constitutes such action, and the environmental impact statement process must be completed before the state can approve or reject the proposal.

DNRC has solicited information from other state agencies regarding the potential impacts of the proposed project on each department's area of expertise. DNRC must also provide information to any state agencies involved in the permitting process. In the case of the proposed project, the only state permits not superseded by MFSA are the air and water quality permits from DHES, a water right permit from DNRC, and an easement across the river bottom from the Board of Land Commissioners (see table 1-1).

FIGURE 1-2. WESTERN MONTANA ENERGY DEVELOPERS SERVICE AREA



Note: Urban areas are not included in the service areas except in the BIA Flathead Irrigation Project and Glacier Electric Cooperative

Source: Compiled by DNRC with information from Northern Lights, Inc.

TABLE 1-1. STATE PERMITS REQUIRED

Activity Requiring Action	Form of Action	Agency Responsible	Legal Authority
Construction of 144MW hydroelectric facility	Grant Major Facility Siting Act Certificate[1]	Department of Natural Resources and Conservation	75-20-101-et. seq. MCA
Appropriation of water	Grant Water Right	Department of Natural Resources and Conservation	85-2-301 et. seq. MCA
Construction affecting air quality	Grant Permit	Department of Health and Environmental Sciences	75-2-211 MCA ARM 16-8-11
Discharge water from construction site	Grant Permit	Department of Health and Environmental Sciences	75-5-401 MCA ARM 16-20
Construction affecting water quality	Authorize Construction	Department of Health and Environmental Sciences	75-5-401 MCA ARM 16-20-633(3)
Crossing river bed	Grant Easement[2]	Department of State Lands	77-2-101 et. seq. MCA

[1] *Certificates are issued by the Board of Natural Resources and Conservation. DNRC acts as staff to the Board, and provides recommendations.*

[2] *Easements are granted by the State Board of Land Commissioners. DSL acts as staff to the Board, and makes recommendations.*

PUBLIC PARTICIPATION

Within 20 days after publication of this draft EIS, DNRC will hold public meetings to obtain public comment on its contents. These comments will be considered in the development of DNRC's recommendations to the Board, which will be contained in the final EIS. The time and place for these meetings will be publicized in advance.

PHOTOGRAPH 2-1 KOOTENAI FALLS

CHAPTER TWO - PROJECT SETTING

To understand the nature of the applicant's proposal, it is necessary to understand the physical and human environment of the proposed project site, as broadly summarized in this chapter. The statements presented here are treated in more depth elsewhere in this EIS with citations and explanations as necessary.

EXISTING CONDITIONS

The Kootenai River originates from headwaters in the mountains of British Columbia approximately 130 mi north of the international border. Flowing across the border into Lincoln County, Montana, it proceeds south approximately 50 mi before turning west and then north in a broad bend into Idaho and back into British Columbia. The Montana portion of the Kootenai valley is narrow with steep densely wooded mountains and narrow floodplains along the river. The total length of the Kootenai River in Montana is 95 mi. The upstream portion of the Kootenai River is dominated by Libby Dam and its reservoir, Lake Koocanusa, which impounds 48 mi of the river in Montana and extends an additional 43 mi into Canada. Libby Dam is a 400 ft high, 420 MW hydroelectric dam that began operation in 1975.

Approximately 26 mi downstream from Libby Dam is Kootenai Falls, the proposed dam site. Flows over the falls are determined primarily by the releases from Libby Dam, which range in a normal year from approximately 4,000 cubic ft per second (cfs), to 40,000 cfs. The annual average flow at the falls is approximately 13,000 cfs, which makes Kootenai Falls the largest undeveloped falls remaining in Washington, Oregon, Idaho and Montana. Investigation by DNRC identified no other undeveloped falls with average flows greater than 4,000 cfs in these states. At its point of exit from Montana, 21 mi downstream from the falls, the Kootenai River has a larger annual average flow (13,910 cfs) than any other river in Montana except the Clark Fork of the Columbia.

The falls do not have a long vertical drop compared to their width. The river channel at the crest of the falls is approximately 700 ft wide. As water approaches the falls, it breaks first over a gently sloping crest, then enters a series of transverse channels that carry most of it to the north side of the river when flows are less than 8,000 cfs. At flows greater than 8,000 cfs, water crosses the transverse channels and goes over the vertical main drop, which ranges in height from 15 ft to 30 ft (see photograph 2-1).

Once over the main drop, the water enters a tumultuous series of rapids and cascades within a narrow bedrock canyon that extends approximately 2 mi downstream from the falls. The river drop in the upper portion of the canyon, including the falls, is approximately 110 ft per mi, compared to the average of about 5 ft per mi in the river reaches upstream and downstream from the canyon.

The appearance and sound of the falls vary greatly with changes in the flow, which fluctuate as much as 6 ft in depth in a day. The plunge and roar of large amounts of water over the falls, the spray, and the undeveloped character of the surroundings are some of the reasons the falls are popular for recreation. Data indicate that about 64,000 people currently visit the falls each year.

A recreation survey that DNRC administered to visitors at the falls found that most of them believed the falls is the only one of its size remaining undeveloped. One question on the survey asked visitors whether there was a scenic attraction comparable to Kootenai Falls near their homes. Among visitors from out of state, 45 percent said there was no place near their homes that could be compared to Kootenai Falls. Of those who compared Kootenai Falls to another place, 71 percent named major national recreation or aesthetic attractions, such as Mt. Rainier, Cape Hatteras, or the Grand Canyon. The remaining percentage compared Kootenai Falls to less known sites.

Despite its location in a narrow transportation corridor, Kootenai Falls remains largely unaffected by man-made developments. Highway 2, which connects the towns of Libby (pop. 2,748) and Troy (pop. 1,088), and provides access to Kalispell 89 mi east and Spokane 165 mi west, passes the falls on the mountainside approximately 600 ft to the south, but is mostly not visible from the falls because of intervening topography and trees. The mainline of the Burlington Northern Railroad passes within 200 ft of the south side of the falls, but the noise of the 20 freight trains and two passenger trains that pass each day is drowned out by the falls when flows are approximately 8,000 cfs or more, which is about half the time. The difficulty in hearing approaching trains has caused the operators of the railroad to be concerned about the safety of persons crossing the tracks to visit the falls.

Recreational development near the falls is minimal and unobtrusive. An overlook maintained by the Libby Lions' Club provides a view of the falls, and trails with some rough and steep spots lead from the overlook to the falls. Downstream from the falls approximately ¼ mi the canyon is spanned by a swinging footbridge. The bridge provides access to the north bank and an exciting crossing for many visitors. On the north bank, the visitor can hike and explore to find a secluded picnic spot or place to fish. Most of the land surrounding the falls is either national forest land or owned by Burlington Northern Railroad and access is virtually unlimited.

One attraction on the north side is the old portage trail that traverses the steep mountainside above the falls and canyon. This trail dates back an unknown period of years and was used by river travelers, including the Kutenai Indians and perhaps their predecessors, to move watercraft and cargo past the falls. There are archaeological sites at both ends of the trail and at various other points near the falls, especially along the north bank upstream. None of the sites near the falls has been studied to any significant extent, but archaeologists say the sites may contain key information regarding the history and prehistory of the area (Davis, C. 1982).

Another attraction near the falls is a section of the original highway (ca. 1908) that traverses the steep north-facing mountainside high above the falls. This road currently is used as a hiking trail and offers many examples of early-day road engineering methods, such as the use of hand-laid stone to build up a roadbed on steep slopes. The steepness of the mountainside is such that observers on the road have a dramatic view of Kootenai Falls in the gorge below, but cannot see either the railroad or Highway 2.

Fishing is an important recreational activity in the falls vicinity. The portion of the river extending approximately 3 mi upstream from the falls is a blue ribbon fishery (DFWP 1980) and one of the most heavily fished stream sections in Montana. Fishermen interviewed in DNRC's recreation survey said they believed that this part of the river was unique in Lincoln County, the state, and even the nation. Although catching fish is important to fishermen, most of those surveyed said enjoyment of scenery was a more important reason for fishing near the falls.

Another recreational feature of the falls area is the Kootenai Falls bighorn sheep herd, which offers the opportunity for wildlife viewing. This herd ranges over the mountains and river terraces on the north side of the river near the falls. One-hundred and seven acres of their range was purchased by the Army Corps of Engineers for preservation as wildlife habitat to partially replace the 24,000 acres inundated by Libby Dam.

The aesthetic qualities of the falls and their popularity as a recreation site are the major reasons there is opposition to the proposed project. The opposition comes primarily from persons who believe the project would seriously damage or destroy the beauty of the falls and the surrounding scenery. The Kutenai Indians oppose the project because they revere the falls as the home of their creator and the center of their religious and cultural life. The loss of 48 mi of river from Libby Dam and the potential loss of another 10 mi from the proposed reregulating dam has generated resistance to the construction of any more dams. The Corps of Engineers proposed to build the reregulating dam to allow higher peak power generation at Libby Dam without corresponding increases in river fluctuation. Analysis of the proposal indicated the benefits would be less than the cost, so Congress withdrew its funding. The Corps still actively supports the reregulating proposal, but its fate is uncertain.

Indications are that the local community is about evenly divided as to whether the Kootenai Falls project should be built. Those favoring the project do so primarily on an economic basis. Research by DNRC showed that construction of the project would bring short-term but badly needed economic benefits to the region. High unemployment in the county is one of the reasons for the strong feelings. Economic activity in the region is limited primarily to lumbering and wood products, with mining becoming more important. The dependence of the wood products industry on national housing trends, interest rates, and other outside influences makes the Lincoln County employment situation subject to many ups and downs.

While it lasted, the construction of Libby Dam ten years ago brought a measure of prosperity to the community. Many of the community facilities that were expanded to accommodate the Libby Dam workers and their families are still in place and could be used by those who would enter the area to take the temporary jobs constructing the proposed project. For example, some school rooms stand vacant and could readily accommodate an influx of students of the magnitude the project would be expected to bring.

The applicant's appropriation of water for the project could have significant social and economic effects, in that it could preclude any further appropriation for consumptive water uses upstream. This might prevent future developments, such as increased irrigation, that could provide long-term employment. (In some parts of the upper Missouri River system, all of the water during most of the year either has been appropriated or is in the process of being appropriated, making it unlikely that any new water-dependent development will occur there).

Another issue is the effect the project construction would have on highway traffic flows. Highway 2 is narrow and winding with short visibility, and Highway Department statistics show it to be one of the most dangerous roads in Montana. There were 185 accidents on the road between Libby and Troy in the last three years. The applicant's proposal to use the highway as a haul road would cause substantial traffic delays and could cause reduced gross vehicle weight limits, and perhaps even temporary closure of the road under bad weather conditions.

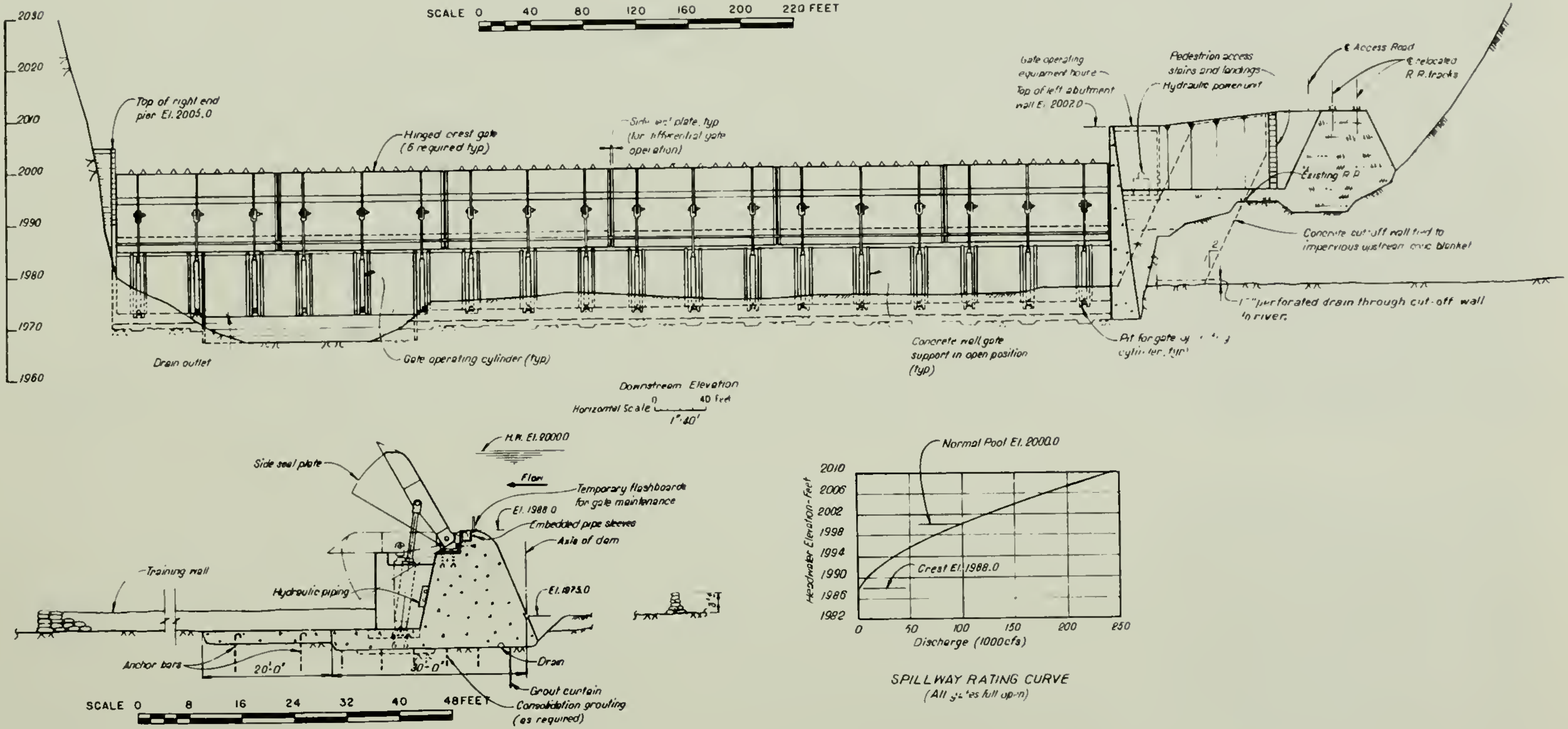

SCALE 0 40 80 120 160 200 220 FEET
2030
2020
2010
2000
1990
1980
1970
1960
Top of right end pier El. 2005.0
Hinged crest gate (6 required typ)
Side seal plate, typ (for differential gate operation)
Gate operating equipment house
Top of left abutment wall El. 2002.0
Pedestrian access stairs and landings
Hydraulic power unit
℄ Access Road
℄ relocated R.R. tracks
Existing R.R.
Concrete cut-off wall tied to impervious upstream clay blanket
1" perforated drain through cut-off wall to river
Pit for gate operating cylinder, typ
Concrete wall gate support in open position (typ)
Gate operating cylinder (typ)
Drain outlet
Downstream Elevation
Horizontal Scale 0 40 feet
1"=40'
H.W. El. 2000.0
Side seal plate
Flow
Temporary flashboards for gate maintenance
El. 1988.0
Embedded pipe sleeves
Axis of dam
El. 1975.0
Training wall
Hydraulic piping
Anchor bars
20'-0"
30'-0"
Drain
Grout curtain
Consolidation grouting (as required)
SCALE 0 8 16 24 32 40 48 FEET
Normal Pool El. 2000.0
Crest El. 1988.0
Headwater Elevation - Feet
2010
2006
2002
1998
1994
1990
1986
1982
0
50
100
150
200
250
Discharge (1000cfs)
SPILLWAY RATING CURVE
(All gates full open)

FIGURE 3-1. DETAIL OF PROPOSED DAM

Source: Northern Lights, Inc.

CHAPTER THREE-
THE APPLICANT'S PROPOSAL

This chapter describes NLI's proposed facilities, and explains how the necessary land would be acquired, how the facilities would be built, operated, and abandoned, and how much they would cost. All information in this chapter is from the applicant and its consultants, unless otherwise attributed.

FACILITIES

Dam and Generation Equipment

The applicant proposes to dam the Kootenai River at the crest of Kootenai Falls with a 925-ft-long, concrete-and-steel dam about 30 ft high (figure 3-1). The concrete portion of the dam would stand about 18 ft above the deepest part of the channel. Along the top of the concrete would be six steel gates, each 127 ft 6 in long and 12 ft high. The gates' hydraulic controls would respond automatically to flow variation, opening or closing the gates as much as necessary to maintain the reservoir's elevation between 1,999 and 2,000 ft above mean sea level. There would be no support piers between adjacent gates, which would abut directly. Experience elsewhere with this system shows that ice and debris could pass over the gates (HARZA 1980). If an unusually large piece of debris could not be passed normally, some powerhouse units could be shut down and one or more gates lowered by the dam operator.

The north end of the dam would be anchored to the mountain with a concrete abutment 5 ft higher than the steel gates and about 20 ft long on top (figure 3-1). At the dam's south end would be a larger abutment, 7 ft higher than the steel gates and extending about 140 ft to the railroad right-of-way. This abutment would contain the hydraulic equipment used to operate the steel gates.

On the south bank of the river 500 ft upstream from the dam, a semicircular intake structure about 200 ft in diameter would extend 125 ft into the reservoir (figure 3-2). The intake structure's only above-water portion, a concrete superstructure about 13 ft thick, would rise 5 ft above the water surface. On top would be a road for the crane that would remove logs and other debris collected by the trashracks through which the intake water would flow. After passing through the trashracks, the water would drop about 150 ft down a vertical shaft 50 ft in diameter to the head tunnel, 1 ft smaller, and travel about 0.6 mi to an underground powerhouse.

The underground powerhouse would contain five turbines sized to power three 36-MW and two 18-MW generators (figure 3-2). The draft tubes that would carry water from the turbines would be equipped with vertical vanes designed to reduce the spiraling motion of the water leaving the turbines. These vanes are part of the applicant's strategy for avoiding the need to inject air into the turbines to maintain smooth operation at low flows. The installation of two 18 MW generators in place of one of the four 36-MW units originally proposed also would help prevent the need for air injection, which is undesirable because it could cause gas supersaturation downstream from the project, endangering aquatic life.

From the draft tubes, the water would enter a discharge tunnel and return to the river channel about 0.8 mi downstream from the dam.

The outlet portal, a horizontal rectangular opening about 20 ft by 100 ft, would be below the river surface at most flows, and the returned water would be released in a direction and at a velocity within the normal range for that portion of the channel. The return water would cause water back up a short distance (less than ¼ mile) into the dewatered reach, depending on the rate of discharge. Both the intake and the discharge tunnels would have bulkheads that could be lowered to prevent the passage of water.

Electricity generated would be transmitted to the existing 115-kV powerline owned by the Pacific Power and Light Company. That line is scheduled to be acquired by the Bonneville Power Administration and upgraded to 230 kV by 1984.

To prevent seepage through the porous soil and rocks, a concrete slab would be placed along the south bank of the reservoir, extending 2,000 ft from the dam upstream. The lower edge of the slab would be imbedded in bedrock. The slab would be covered with waste rock from excavation and graded to slope gently to the water's edge. Waste rock would be applied and graded for another 2,000 ft upstream from the end of the slab, so that 4,000 ft of the south riverbank upstream from the dam would be so treated.

Irregular concrete structures, textured and colored to mimic natural rock, would be installed to partially block the north-sloping transverse channels between the crest of the falls and the main drop, in an effort to force water over the southern end of the main drop, which otherwise would be dry at the applicant's proposed minimum flow of 750 cfs. The purpose of the structures would be to make the flows appear higher than 750 cfs. The structures would be mostly submerged.

Recreation Facilities

The existing recreational facilities near the falls are described in chapter four. The applicant proposes to change those facilities, add new ones, and provide better maintenance. Up to 20 new picnic tables and sealed vault toilets in heated log buildings would be built by the applicant. A gravel-surfaced, rip-rapped trail, realigned to provide easier walking than allowed by the existing trails, would lead (via a pedestrian underpass beneath the railroad tracks) to a new overlook of the falls about 400 ft downstream from the dam, built with native stone and earthfill (figure 3-3). Interpretive signs and pamphlets would be provided. The applicant said it would add more recreational facilities if recreational use of the area warrants them.

After construction, four parking areas near the dam would remain, all of them north of Highway 2 and all available to the public (figure 3-3).

LAND ACQUISITION

NLI intends to negotiate easements to use the land in the reservoir area, but would purchase the land if necessary. These easements would be for all land the project would inundate above the present low water mark. NLI also intends to either purchase or obtain long term lease agreements for all land required for project structures (figure 3-4).

To date NLI has not acquired rights to any land on which the proposed project would be located. Negotiations have been initiated with the Burlington Northern Railroad and with Kootenai National Forest although no contracts or special use permits have been signed. Negotiations have not been initiated with the Montana Department of State Lands, the agency responsible for recommending to the Board of Land Commissioners whether an easement for use of the river bottom should be issued.

Table 3-1 lists land ownership in and immediately adjacent to the proposed project site.

TABLE 3.1. LAND OWNERSHIP IN THE PROJECT AREA

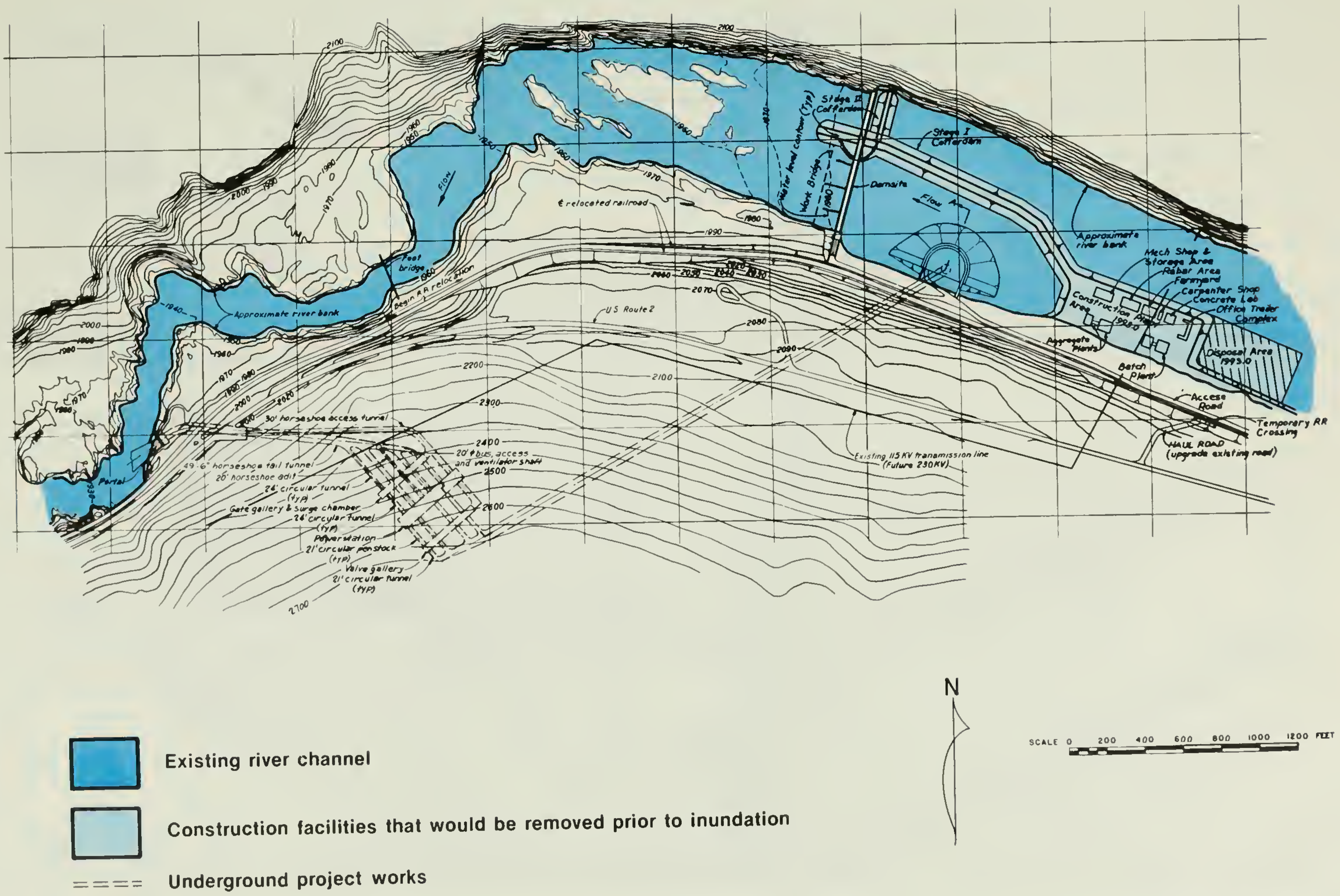
Property	Owner	Acres
Total riverbed (low water to low water)	State of Montana	190.1
Section 13 T31N R33W south of Kootenai River	Burlington Northern Railroad	142.0
Lot 7, Section 14 T31N R33W	Private Individual	19.9
Homestead Survey (HES) 443 & 579	U.S. Army Corps of Engineers	31.2
All other affected land	Kootenai National Forest	117.2
	TOTAL	500.4

CONSTRUCTION

Construction is proposed to begin in June, 1984, and continue for 4.5 years, with completion scheduled for January, 1989.

The project's work force, which would peak at about 500 workers during the second and third years of construction, is discussed in more detail in the Social and Economic Concerns section of chapter four. To reduce traffic congestion and the need for parking space, the contractor would be required to provide parking in either Libby or Troy and transport workers to and from the site by bus.

FIGURE 3-2. CONSTRUCTION LAYOUT



- ▇ Existing river channel
- ▭ Construction facilities that would be removed prior to inundation
- ==== Underground project works

Source: Northern Lights, Inc.

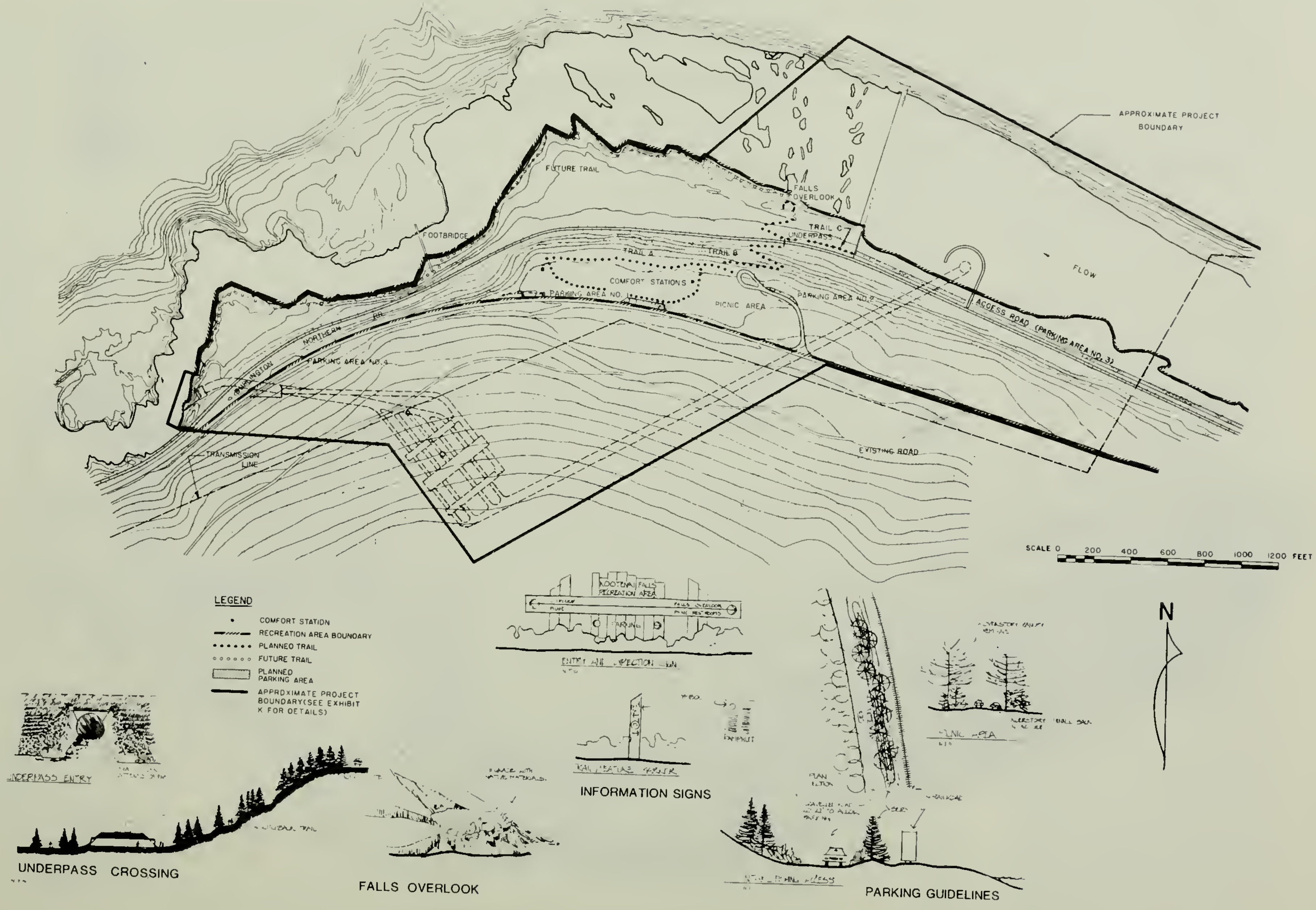
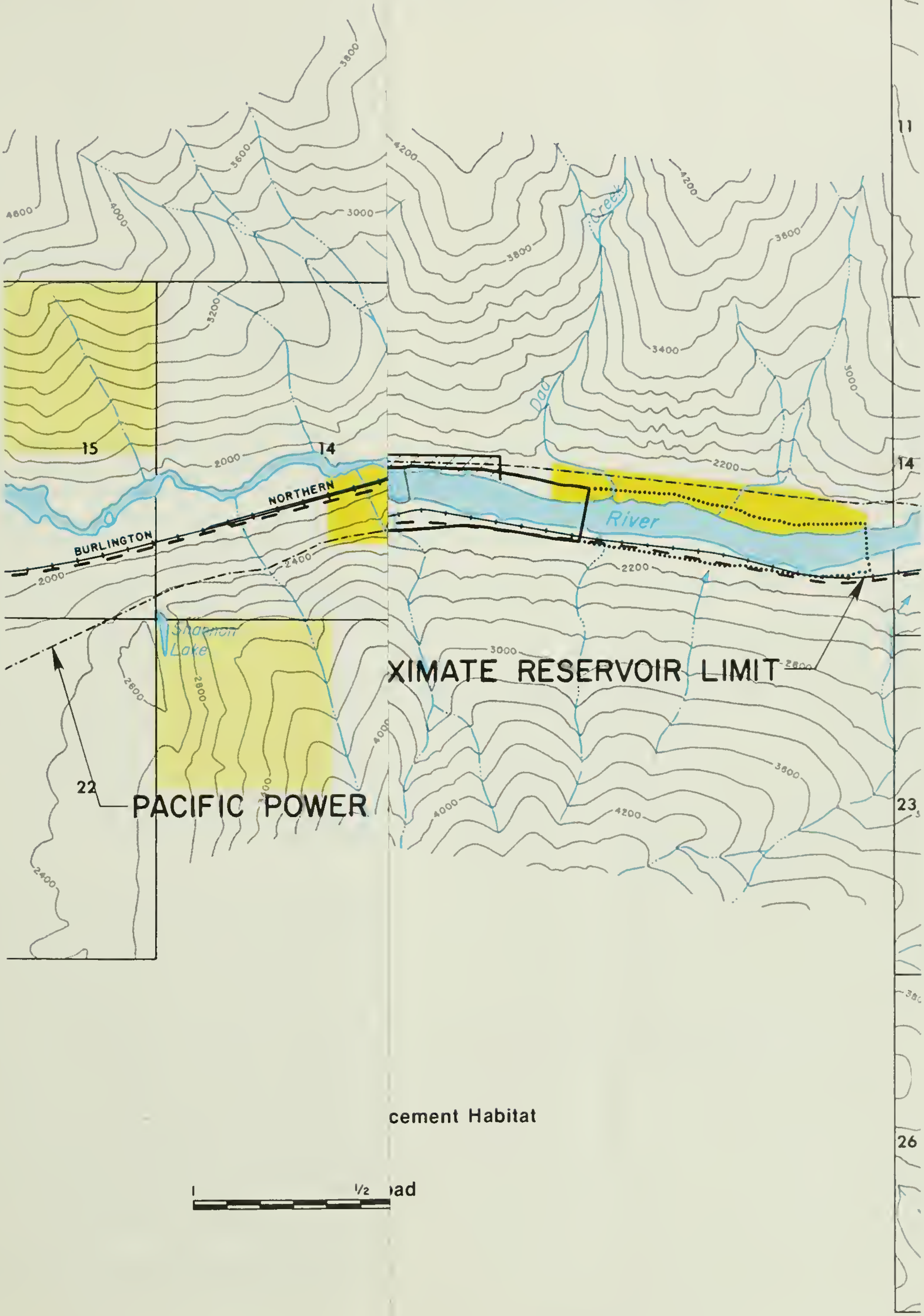


FIGURE 3-3. PROJECT SITE PLAN

Source: Northern Lights, Inc.

IP IN THE PROJECT AREA



cement Habitat

1 ½

ad

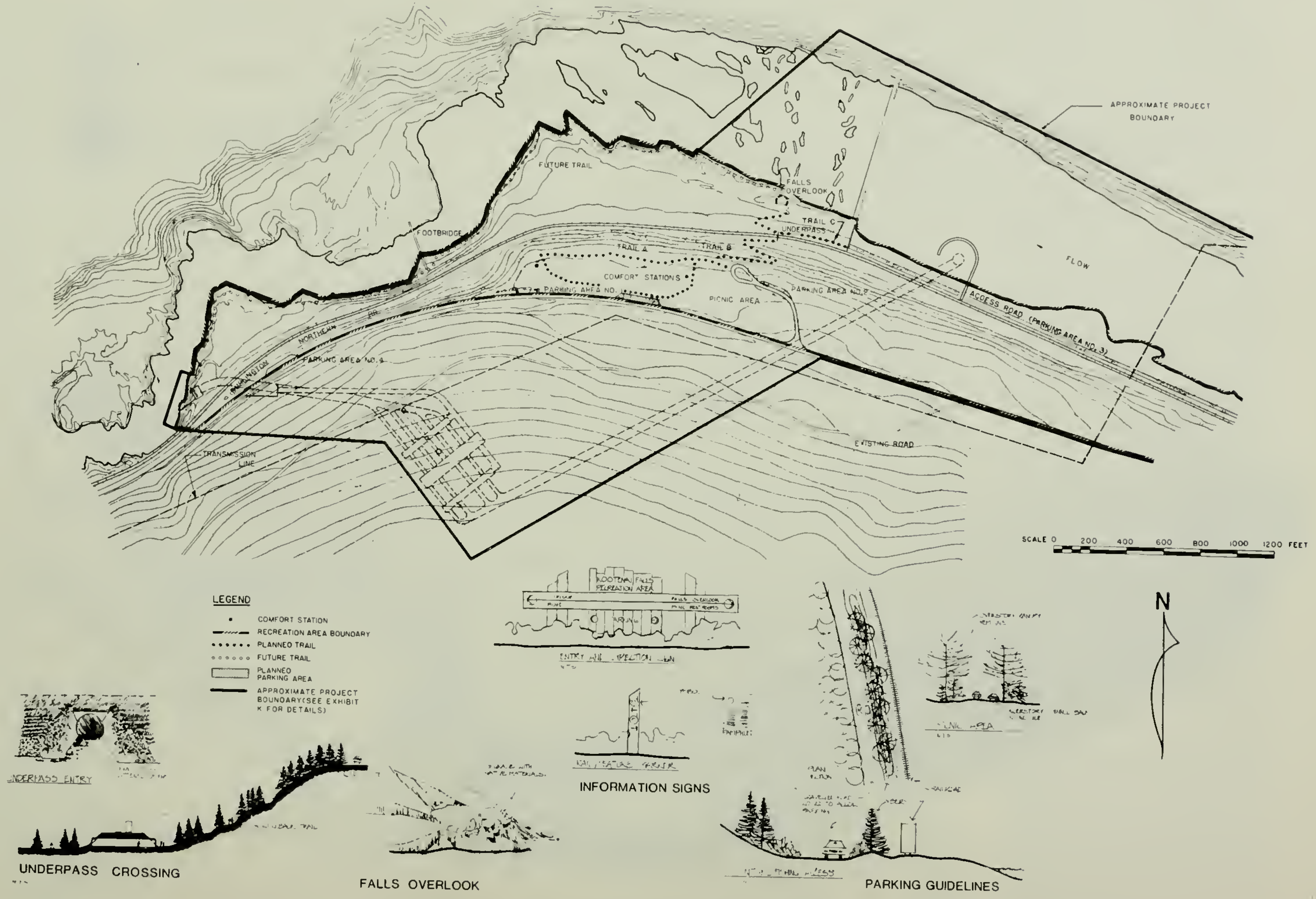
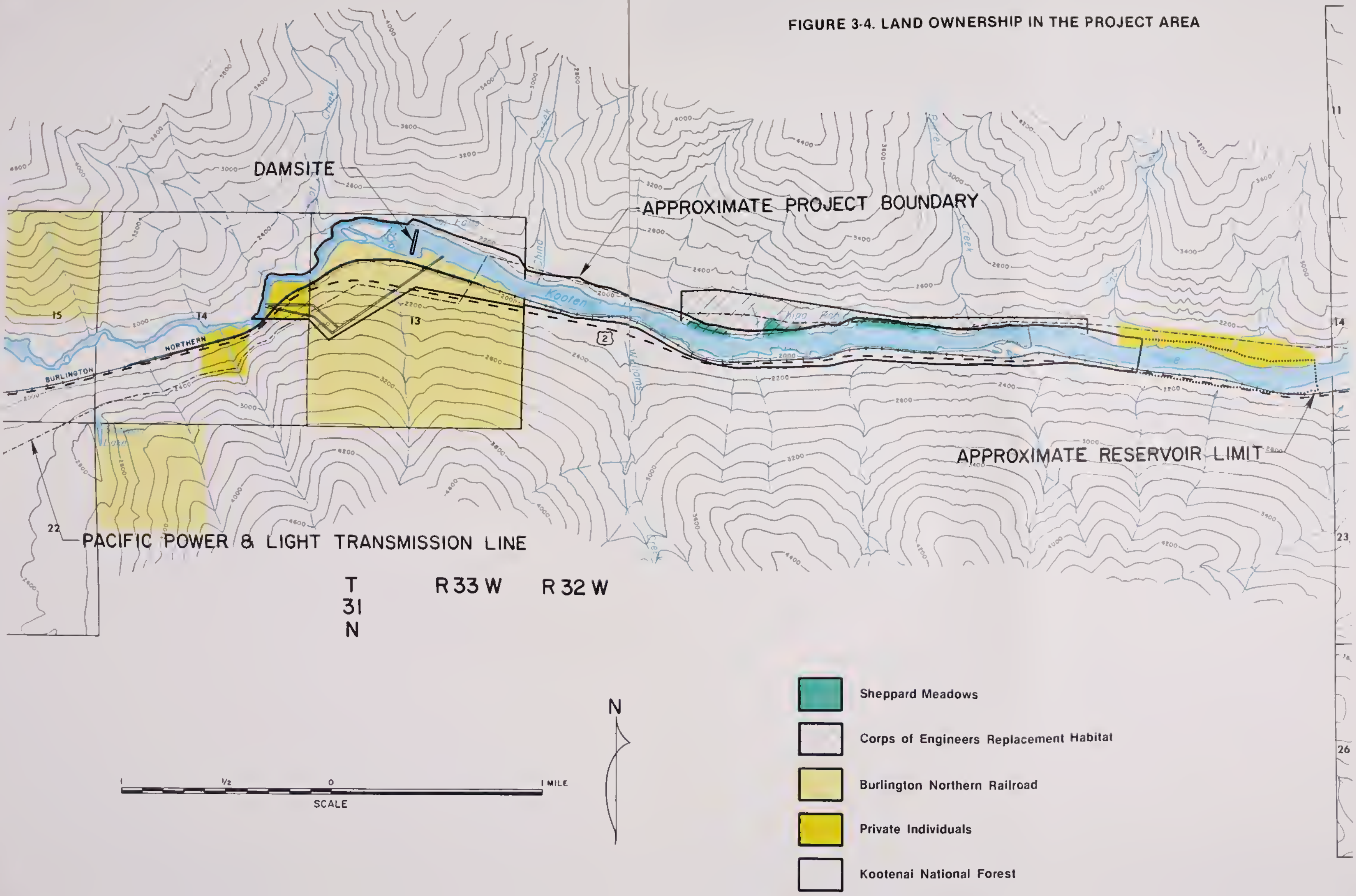


FIGURE 3-3. PROJECT SITE PLAN

Source: Northern Lights, Inc.

FIGURE 3-4. LAND OWNERSHIP IN THE PROJECT AREA


DAMSITE
APPROXIMATE PROJECT BOUNDARY
APPROXIMATE RESERVOIR LIMIT
PACIFIC POWER & LIGHT TRANSMISSION LINE
BURLINGTON NORTHERN
Kootenai
2
15
14
13
22
11
23
26
T 31 N
R 33 W
R 32 W
1 ½ 0 1 MILE
SCALE
N
Sheppard Meadows
Corps of Engineers Replacement Habitat
Burlington Northern Railroad
Private Individuals
Kootenai National Forest

Water needed for construction would be pumped from the river. Potable water would be provided in the most convenient manner, possibly as bottled water. Sewage from workers at the construction site would either be treated in a package sewage treatment plant or hauled by truck to an existing sewage treatment plant, depending on the contractor's preferred method and his agreement with the Montana Department of Health and Environmental Sciences.

Sediment ponds in the construction plant area and in the dewatered riverbed protected by the first cofferdam would be used to catch runoff sediments from the project. Ditches would convey runoff from material stockpiles to the ponds. The ponds would be dried occasionally and the sediments removed and incorporated as part of the permanent fill.

First Year

During the first year, a road would be built from the access tunnel portal through an underpass beneath Highway 2, and westward to its intersection with the highway, the first stage cofferdam would be placed, the construction plant area and waste rock processing and concentrating plants would be prepared, the access road built to the construction staging area, the southern half of the spillway begun, tunneling started, and railroad relocation begun.

River diversion for construction in the dam area would be in two phases. In the first phase, an earth and rockfill cofferdam would be built (using waste rock from excavation) to dewater the south half of the river channel, including the site of the intake structure and construction area. The southern four spillway bays, the south abutment, and the intake structure would be built in the area dewatered by this dam.

Some of the waste rock from excavation (146,000 cubic yards of it) would be used to build up about 800 ft of the south river channel where the construction offices, aggregate plant, batch plant, carpenter shop, machine shop, concrete laboratory, bulk cement bin, rebar storage area, sediment ponds, rock crusher, and storage piles of waste rock, sand and gravel, and topsoil would be built. The built-up area would begin 600 ft upstream from the water intake structure (figure 3-2), would extend into the river channel at most 250 ft, measured from the current south shoreline, and would have a surface elevation of 1,993 ft. All facilities in the built-up area would be removed before the reservoir is filled. Filling the reservoir would submerge the rock surface about 7 ft.

The railroad access road shown in figure 3-2 would be improved to accommodate heavy trucks and construction equipment, and a new access road built on the railroad right-of-way from the improved railroad access road to the vicinity of the intake structure.

Tunneling also would begin the first year. According to the applicant, tunnels would be excavated by blasting. During the two years of excavation, about 850,000 cubic yards of rock would be removed.

Tunnel excavation would begin at the tunnel access portal south of Highway 2 and west of the proposed dam (figure 3-2). Waste rock from the tunnel system would be hauled east by truck on Highway 2 or transported by conveyor belt about 1 mi to the vicinity of the construction plant on the south bank of the river just upstream from the proposed dam. There it would be crushed and used as fill or concrete aggregate in the project. (If the waste is hauled by truck, there would be a truck entering the highway every 4 to 5 minutes, on the average.) About the ninth month of construction, the contractor would begin stockpiling excess crushed rock in the construction plant area (figure 3-2) for later use in the project or for sale to other users as railroad ballast or road fill. A large area would be required for stockpiling the excess. Stripped surface materials for use in reclamation would be kept in adjacent stockpiles.

About 2.3 mi of the Burlington Northern Railroad's mainline tracks, which run along the south side of the river, would be moved approximately 50 ft to the south and raised as much as 16 ft. The relocated portion would stretch from a point 1.5 mi above the dam to a point 0.8 mi below the dam. About 10 acres would be disturbed during the relocation, all of it within the existing 200-ft-wide railroad right-of-way. A new railroad siding would be built on existing railroad right-of-way west of the project area. The applicant would use the present siding for delivery and storage of construction material. When construction is finished, it would be removed.

Electrical power for construction would come from an existing NLI transmission line. Two transformers, one at each end of the project area, would convert the voltage to a usable level. Construction would use 1 million kWh of electricity the first year, 1.5 million kWh the second, 2.1 million kWh the third, 2 million kWh the fourth, and 700,000 kWh the fifth.

Second Year

During the second year of construction, tunneling and the relocation of the railroad would be finished, part of the first cofferdam removed and the second cofferdam and a temporary work bridge built, the northern half of the spillway and north abutment begun, construction of the powerhouse begun, and the intake structure and outlet portal built.

Construction of the second cofferdam would be finished after completion of the work bridge and installation of the four southern spillway gates. The portion of the first cofferdam next to the spillway could then be removed, allowing the river to flow through the completed portion of the spillway.

Construction of the discharge portal (figure 3-2), would require special construction methods because much of it would be done underwater. First, a large vertical slot about 140 ft deep would be incised between the powerhouse and the site of the discharge portal, as close to the latter as feasible. Then a closure bulkhead would be installed in the slot to prevent water from the river from entering the outlet tunnel, which would be excavated from the powerhouse to the bulkhead. On the river side of the bulkhead, a trench would be dug from ground surface to a depth necessary for the outlet tunnel and portal—at its deepest point, about 27 ft below the river bottom.

Excavating for the discharge tunnel would require some underwater blasting the second year of construction. No cofferdams would be used because of the limited workspace. Instead, concrete would be placed underwater through a pipe designed for the purpose. When the discharge portal is completed, the contractor would backfill to the level of the original ground surface between the portal and the closure bulkhead.

Talus slopes at the north abutment would be stabilized with steel mesh, shotcrete, or grout before construction of the abutment.

Third Year

By the end of the third year, the northern spillway bays and gates would be completed, the cofferdams and temporary work bridge removed, and construction of the powerhouse continued.

Fourth Year

The powerhouse would be finished the fourth year, and the underground switchyard and the short, connecting transmission line would be built. The first generating units would then come on line. The proposed recreational facilities would be built, and reclamation would begin on altered land.

The only land proposed for reclamation is 11 acres along the southern bank where rockfill and a concrete slab would be placed the first year. Topsoil from those acres would be stockpiled until the fourth year and then replaced, contoured, seeded with native grasses, and planted with native riparian vegetation. The contouring would create small, sheltered bays to promote the growth of riparian habitat and wildlife production.

Fifth Year

In the last half-year of construction, all mechanical and electrical work would be finished and the last generating unit brought on line.

OPERATION AND MAINTENANCE

Generating Capacity

The powerhouse would have the capacity to generate up to 144 MW, but would generate an average of 58.8 MW under normal flow variations.

Reservoir Control

The reservoir created by the dam would have a maximum surface of about 232 acres. At 50,000 cfs, about 77 acres not now covered by the river at that flow would be inundated. The reservoir would reach about 4.5 mi upstream from the dam. It would have a capacity of about 3,860 acre-feet (af). The amount of time required to discharge the volume of the reservoir would vary from about 2 hrs at 25,000 cfs to about 21 hrs at 2,750 cfs.

The applicant proposes to release a flow of at least 750 cfs over the dam at all times, passing over the full width of the dam. The applicant said that the depth of the flow over the dam at 750 cfs would be approximately 9 in, but provided no supporting calculations. DNRC calculates that the flow would be slightly more than 5 in at the upstream edge of the spillway crest, and less as the water picks up velocity in spilling over the dam (Rubich 1981a).

The slowing of the water as it enters the reservoir would cause the sediments transported by the water to be deposited, with the coarser particles settling out first, followed by progressively finer sediment as the water moves downstream. Some of this material would be resuspended periodically when water velocity increases, but most would remain in the reservoir.

The applicant estimated that if the Libby reregulating dam were built, about 14 af of sediment would be deposited in the Kootenai Falls reservoir each year, so that 18 percent of the reservoir would be filled with sediment in 50 years. If the reregulating dam were not built, about 34 af of sediment would be deposited each year, filling 44 percent of the reservoir in 50 yrs. The applicant said this sedimentation would have no effect on the hydroelectric operation, which is not dependent on water storage.

The lowest river flow that would allow generation of power would be 2,750 cfs, providing 2,000 cfs for the turbines (enough to run one of the 18-MW generators at two-thirds capacity) and 750 cfs for passage over the falls. At flows higher than 2,750 cfs, the turbines would be run in varying combinations to give the greatest efficiency at any given flow. At 25,150 cfs or more (7 percent of the time) all the turbines could be operated at full capacity, with 750 cfs available for maintaining the proposed minimum flow over the dam. No power would be generated at flows below 2,750 cfs (less than 0.2 percent of the time), and no additional power could be generated at flows above 25,150 cfs, with all water in excess of this flow passing over the dam and falls. (The Army Corps of Engineers agreed, after negotiations with the Montana Department of Fish, Wildlife, and Parks, the Libby Rod and Gun Club, and other interested parties, to release no less than 4,000 cfs from Libby dam under normal circumstances, and to release no less than 2,000 cfs even in emergencies. Figure 3-5 shows the monthly flow variation in the Kootenai River.

Flood Potential

The project would be operated to maintain the reservoir surface elevation between 1,999 ft and 2,000 ft above mean sea level at all times. At flows above 25,150 cfs, which would be the maximum capacity of the turbines plus the minimum flow over the dam, the gates in the dam would be opened as much as necessary to maintain the desired reservoir elevation. When wide open, the gates could pass 90,000 cfs while maintaining the 2,000-ft reservoir elevation. Including the capacity of the turbines, total river flow could reach 114,400 cfs (more than double the expected 100-year flood of 52,000 cfs) before the reservoir would rise above 2,000 ft.

The reservoir would have no significant storage capacity, and could not be used for flood control.

Operating Personnel

The plant would be operated and maintained by twenty workers (electricians, mechanics, and laborers)—divided among three shifts. They would be headquartered in the underground powerhouse, which they would enter through an access tunnel. An operator would be on duty in the powerhouse at all times.

Operation and maintenance personnel would have access to the north abutment either with workboats or overland on one of the trails north of the river. Little maintenance is expected to be required at the north abutment.

ABANDONMENT

When the project is no longer economical to operate, it would be abandoned. (Elsewhere in this EIS, a 50-year project lifetime is mentioned. That figure is used for accounting purposes only; it is not a projection of when the dam might be abandoned.) The methods used in abandoning it would depend largely on the amount of sediment accumulated in the reservoir. (All information in this section from Allen, A. 1981b.)

If the sediments have accumulated no farther downstream than the intake by the time abandonment is scheduled, the steel gates would probably be removed and the concrete portions left in place. Removal of the gates would cause the river to cut into the sediments, but the remaining 18-ft-high concrete portion of the dam would provide a basin to retain sediments. The concrete portion of the dam could not be removed without large masses of sediment being released, causing water quality impacts downstream.

The steel gates would probably be left in place upon abandonment if the sediments have reached to or near the dam. Retention of the gates would provide a larger settling basin for the sediments and lessen downstream sedimentation. The life of the gates could be extended after abandonment by adding a concrete section across the top. Whether the steel gates were retained or removed, the abandoned dam would remain indefinitely. Eventual resumption of the natural downstream sedimentation would occur.

Upon abandonment, all valuable or usable parts of the facility would be removed. The tunnels would be flooded and plugged at both ends with concrete. The applicant said that access roads would either be left for public use after project abandonment or graded to prevent use by vehicles, depending on the desires of the public.

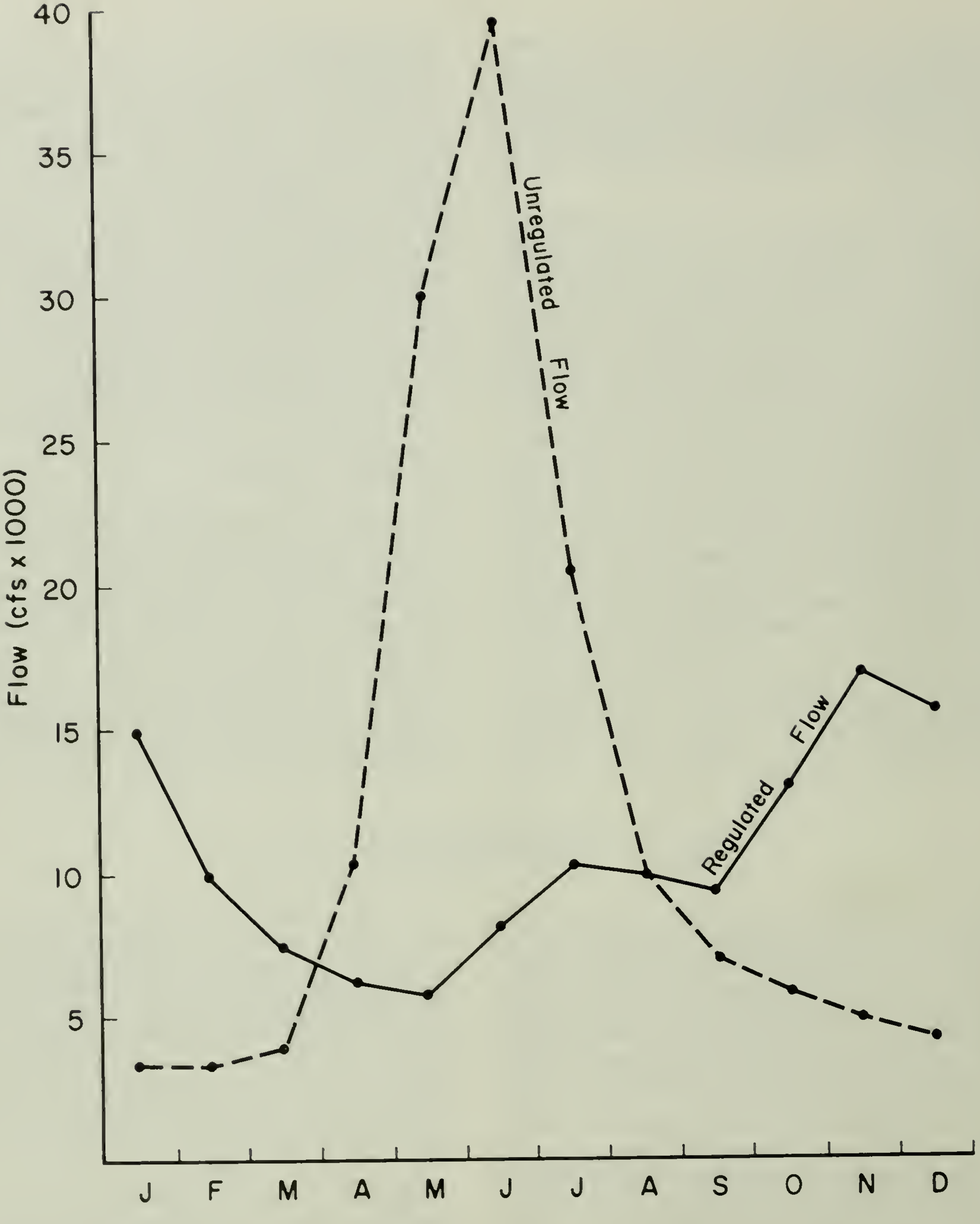


FIGURE 3-5. MONTHLY AVERAGE OF MEAN DAILY DISCHARGE

USGS Gaging Station 2 miles upstream from Libby, Montana (Unregulated prior to Libby Dam 1910-1965, and regulated by Libby Dam 1975-1980)

Source: USGS

COSTS

NLI submitted the estimate of construction cost for the project, excluding interest during construction, shown in table 3-2 (in November 1981 dollars).

TABLE 3-2. ESTIMATED CONSTRUCTION COSTS (1981 DOLLARS)

1.	Land and land rights	$ 5,390,000
2.	Power plant structures and improvements	34,089,000
3.	Reservoir, dam, and waterways	81,932,000
4.	Water wheels, turbines, and generators	42,503,000
5.	Accessory electric equipment	6,273,000
6.	Miscellaneous power plant equipment	2,583,000
7.	Roads, railroads, and bridges	523,000
8.	Substation and switching station equipment	5,149,000
	Subtotal Direct Cost	$178,442,000
9.	Contingencies (15% of items 1, 2, 3, and 7)	18,290,000
10.	Contingencies (8% of items 4, 5, 6, and 8)	4,521,000
	Total Direct Cost	$201,253,000
11.	Administration and engineering (12% of direct cost)	24,150,000
	Total Project Cost (excluding interest during construction)	$225,403,000*

Source: *Chen 1982.*

* *DNRC based its analysis on cost estimates presented in the original MFSA Application, which were given in 1978 dollars. Conversion of the figures to 1981 dollars gave an estimated project cost, including interest, of $221 million.*

PHOTOGRAPH 4-1 KOOTENAI FALLS AREA

CHAPTER FOUR — SOCIAL, ECONOMIC AND ENVIRONMENTAL CONCERNS

This chapter examines the current status of the portions of the environment that would be affected by the proposed dam, discusses the impacts that would result from development, and explores the possibilities for reducing them. Photograph 4-1 shows the Kootenai Falls area.

The reader will note that "Kootenai" is spelled in different ways. "Kootenay" is the Canadian spelling, and the Kutenai Indians use their own spelling. "Kootenai" is the normal spelling in this country.

GEOLOGY AND HYDROLOGY

EXISTING ENVIRONMENT

The flow characteristics of any river have major effects on its hydrological and aesthetic qualities.

Before completion of Libby Dam in 1972, the Kootenai River exhibited flow patterns characteristic of large rivers with high flows caused by snowmelt runoff. The highest flows were in the spring with daily maximum discharges exceeding 50,000 cfs and sometimes approaching 100,000 cfs. Lowest flows of the year were in the winter and generally more than 2,000 cfs.

Since Libby Dam began operation, the timing of high and low flows has been reversed. This trend was shown in chapter three, figure 3-5, which shows mean monthly discharges for representative years before and after regulation. Regulation by Libby Dam decreased the range of annual variation significantly but increased the range of daily variation. At present, flows at the falls vary from about 4,000 cfs to 40,000 cfs over an average year.

To aid in the maintenance of downstream aquatic habitat, the Corps of Engineers and the Montana Department of Fish, Wildlife, and Parks (DFWP) have cooperatively placed restrictions on flow releases from Libby Dam. From May through September, the maximum allowable downstream increase in water surface elevation is 1 ft/hr not to exceed 4 ft/day. From October through April a maximum increase of 2 ft/hr and not more than 6 ft/day is allowed. The normal minimum outflow from Libby Dam is 4,000 cfs with 2,000 cfs as the absolute minimum allowed under the agreement between the Corps and DFWP (USCE 1975).

RIVER SEGMENT AFFECTED

Within the area affected by the proposed project, two geographic areas may be identified for analysis of physical impacts. The first is the 4.5 mile channel reach that would be affected by the backwater of the proposed dam, referred to as the reservoir area. The second is the partially dewatered reach which extends downstream from the dam 0.8 miles to the proposed outlet tunnel.

The Partially Dewatered Reach

Kootenai Falls is a sharp break in the long channel profile of the Kootenai River. Erosion within the reach extending 2 mi downstream from the falls has created a series of complex bedrock channels and drops that constrain the flow of the river, producing a sequence of scenic falls, cascades and rapids. The Kootenai river drops approximately 90 ft (110 ft/mi) in elevation over the 0.8 mi portion of the river that would be partially dewatered by the project, contrasting with the average drop of approximately 5 ft/mi for the channel reaches upstream from the falls and downstream from the canyon below the falls.

Within the partially dewatered reach the Kootenai River is bounded by cliffs with narrow flat benches

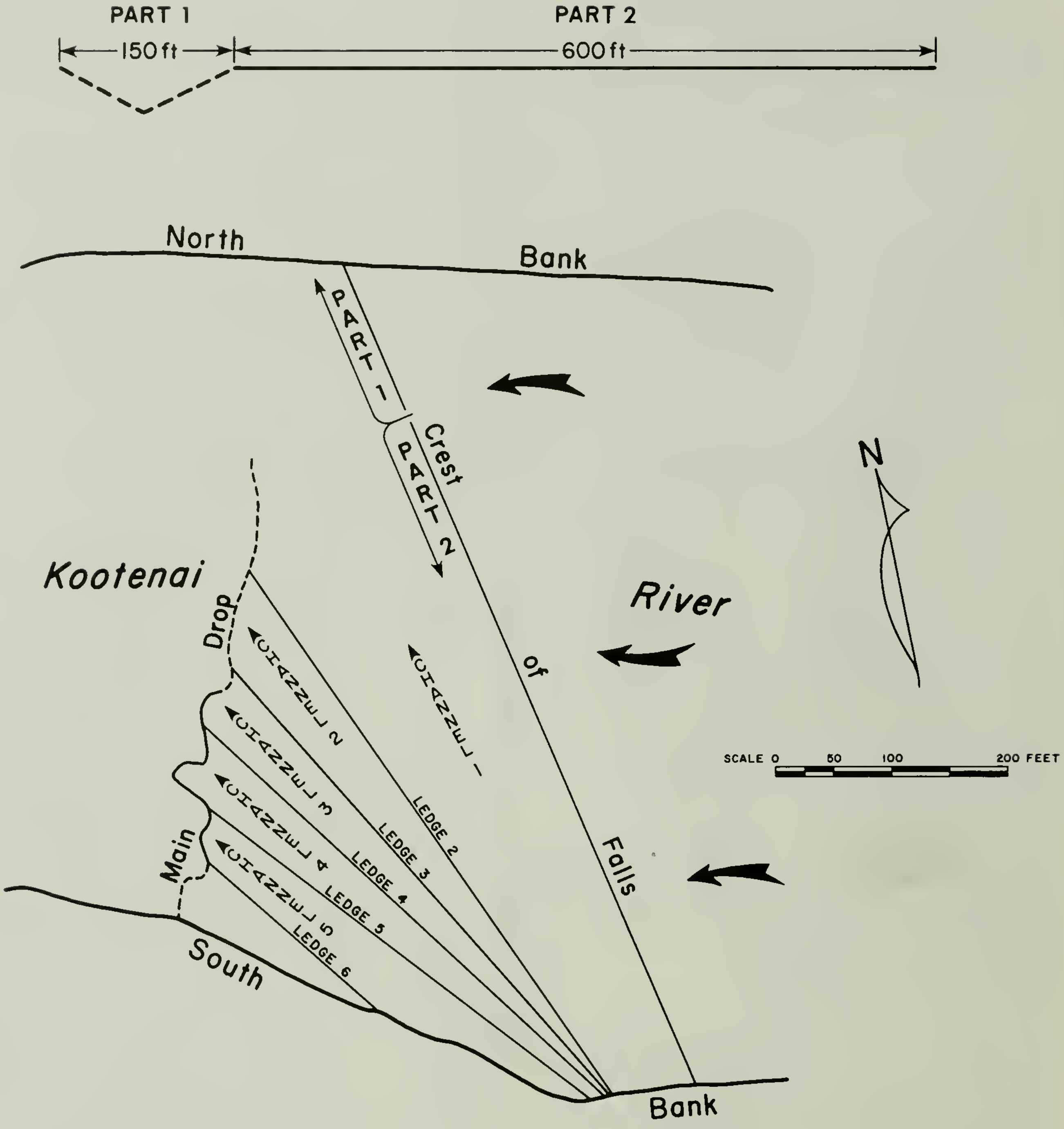
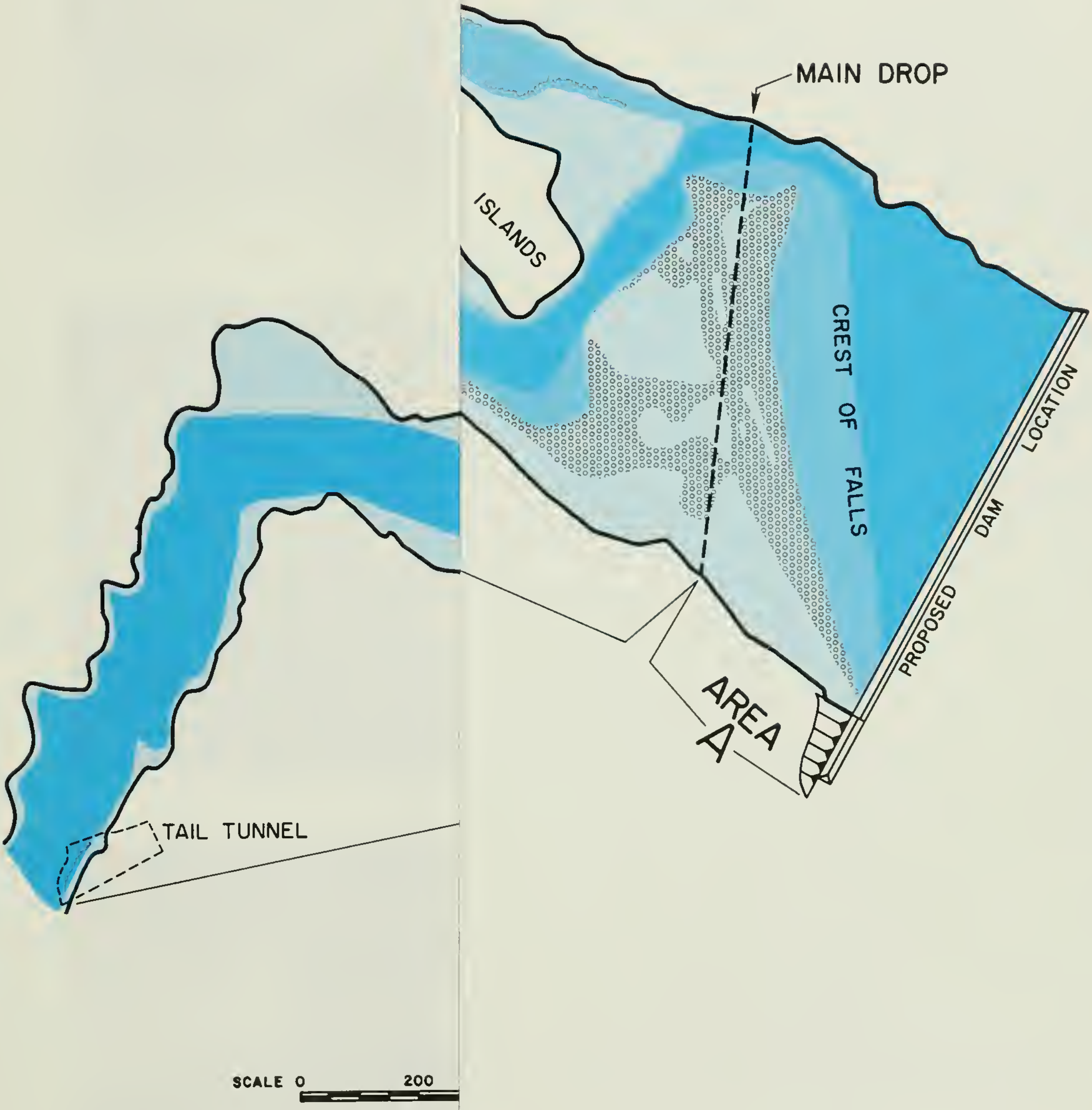


FIGURE 4-1. CREST OF KOOTENAI FALLS

Source: DNRC

ATERED REACH



Source: DNRC

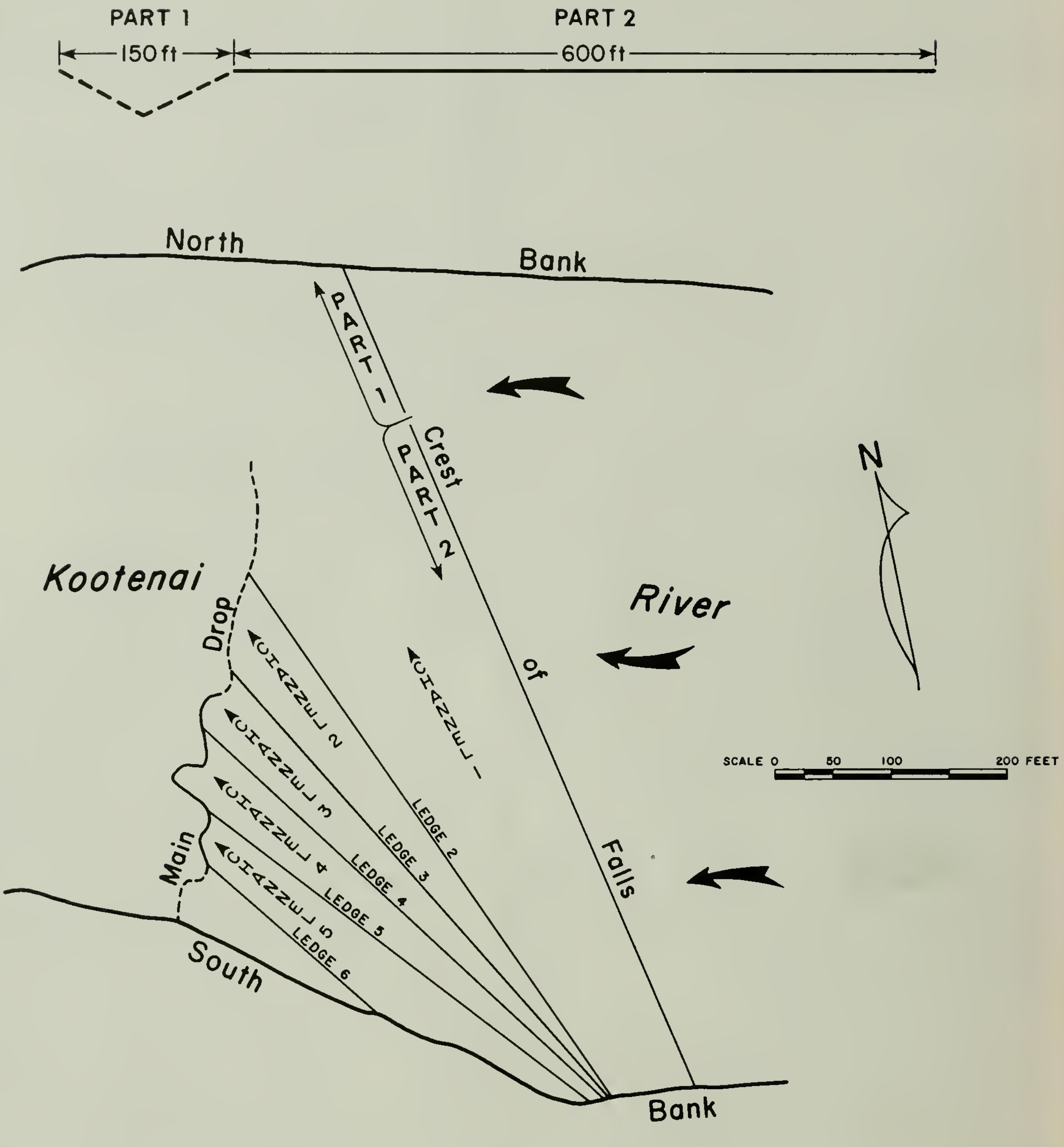
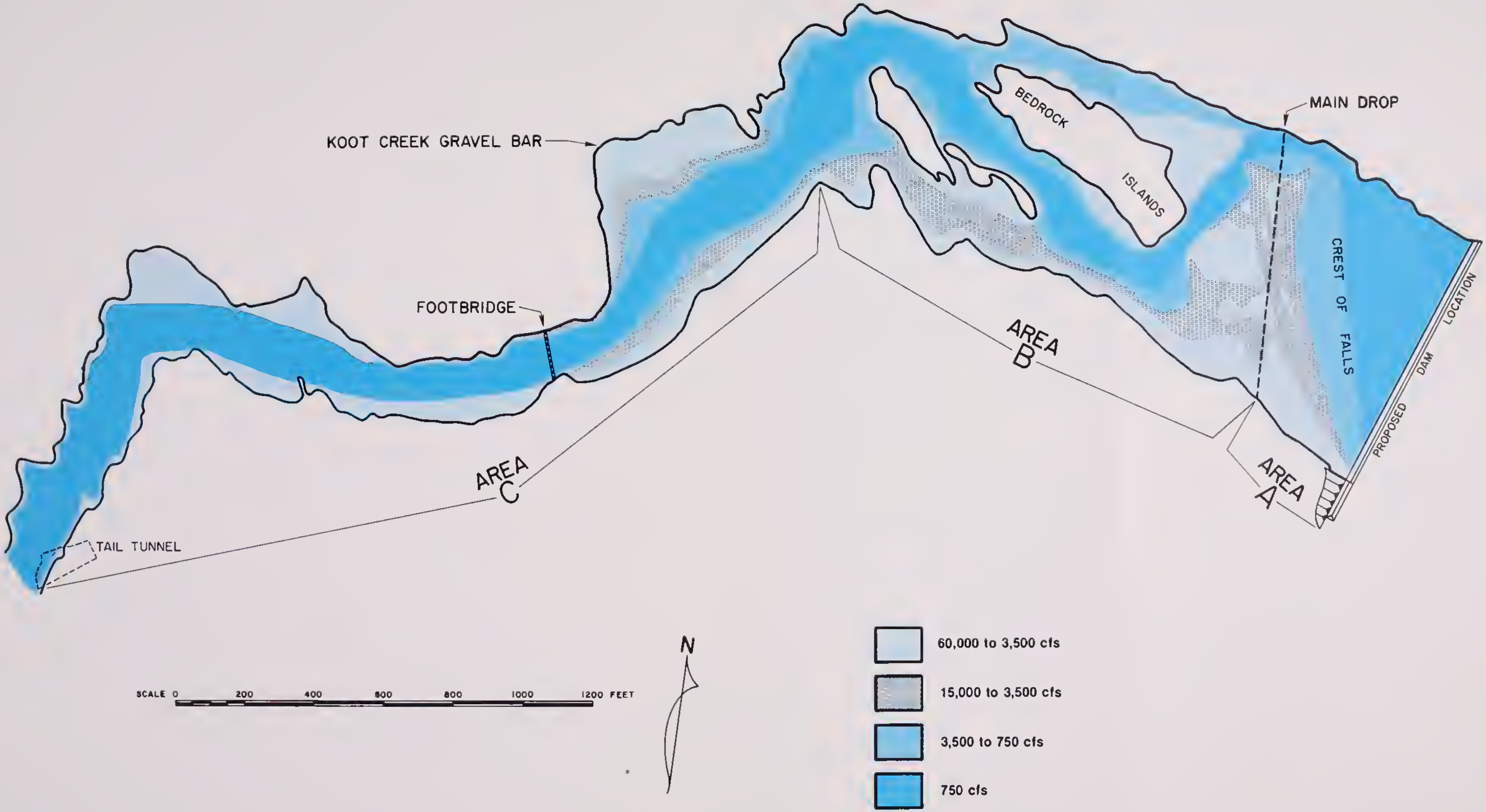


FIGURE 4-1. CREST OF KOOTENAI FALLS

Source: DNRC

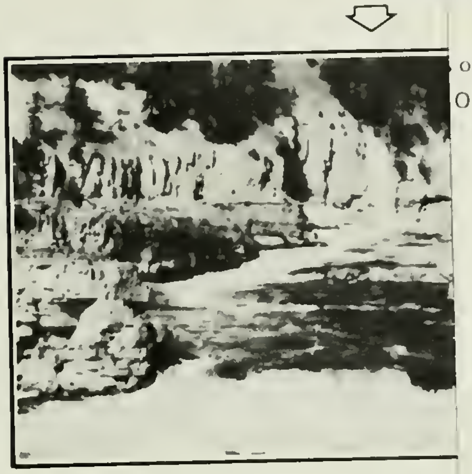
FIGURE 4-2. PARTIALLY DEWATERED REACH



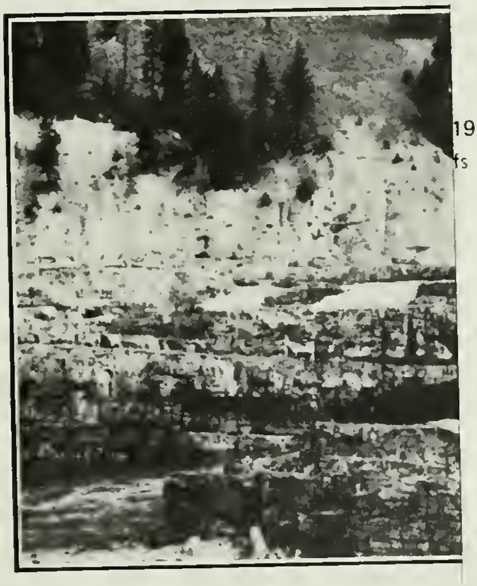
☐	60,000 to 3,500 cfs
▨	15,000 to 3,500 cfs
🟦	3,500 to 750 cfs
🟦	750 cfs

Source: DNRC

RAPH 4·2 THE FALLS AT VARIOUS FLOWS



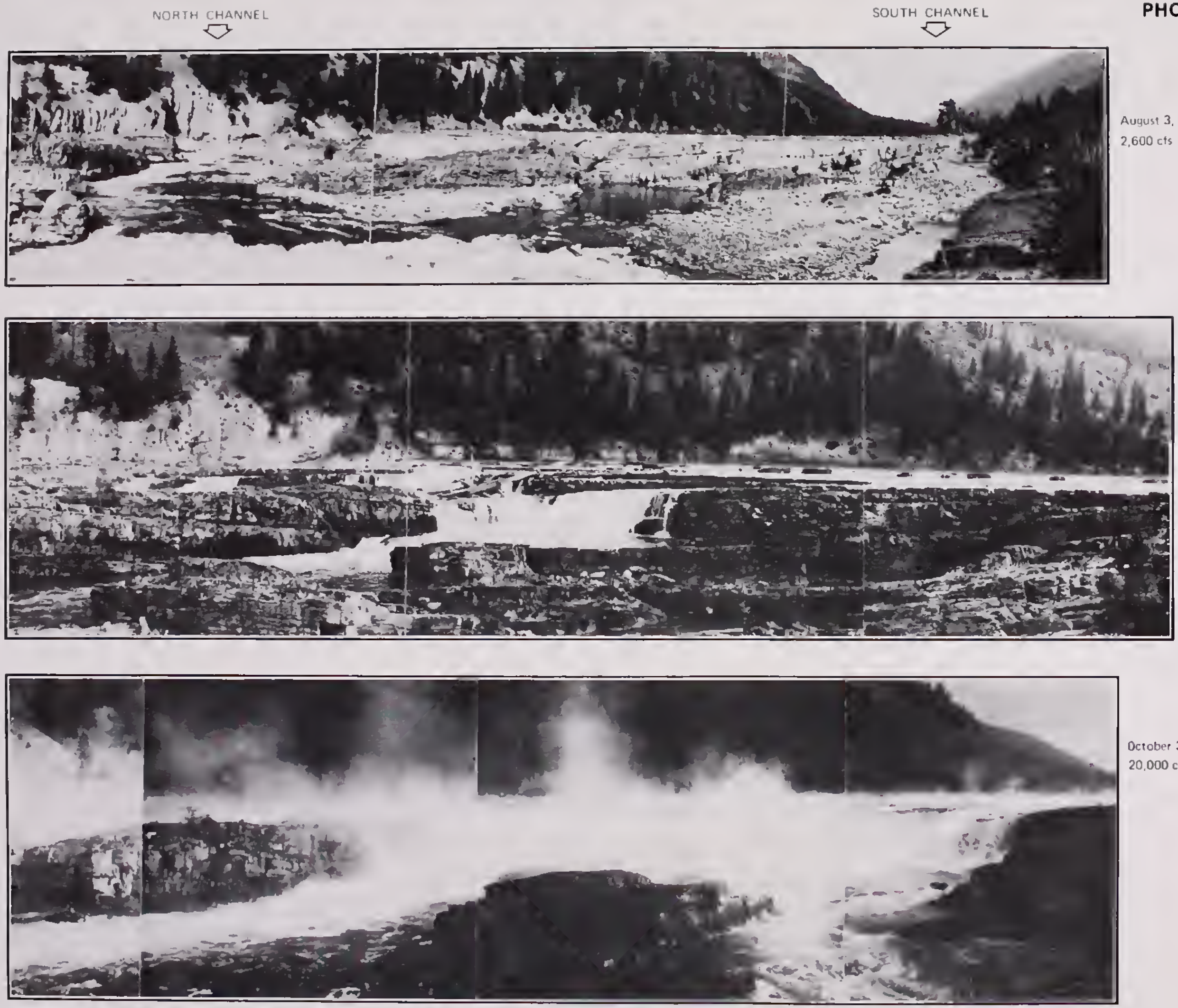
of Falls
Overlook Areas On South Bank



1978
fs

PHOTOGRAPH 4·2 THE FALLS AT VARIOUS FLOWS

Views of Falls
From Overlook Areas On South Bank



August 3, 1975
2,600 cfs

May 9, 1978
5,700 cfs

October 31, 1978
20,000 cfs

adjacent to the channels. There are three geomorphic and hydraulic regions in the reach (Dalby 1981b). The area 200 to 300 ft downstream from the crest of the falls (figure 4-1) comprises a series of parallel bedrock ledges and shallow channels that transect the Kootenai River at roughly a 30 degree angle. These features exert an important control on the distribution of flow within and immediately downstream from the area between the crest of the falls and the main drop.

The three hydraulic and geomorphic areas are shown as Area A, B, and C, in figure 4-2. The relatively gentle slope of Area A begins at the crest and ends at the main drop in the falls, a free-fall of approximately 30 ft. Area B extends from the base of the main drop to a point about 1,000 ft above the footbridge. The water in this stretch flows in three main channels created by two large bedrock islands and several lesser bedrock protrusions. The north and middle channels carry water at all flows; the south channel is nearly dry at discharges less than about 4,500 cfs. Area C extends from a point about 1,000 ft above the footbridge downstream to the proposed site of the outlet tunnel portal. The river in Area C flows in a single deep channel bounded by predominantly bedrock cliffs.

The hydraulic characteristics of flow moving through the partially dewatered reach influence the aesthetics, recreational and biologic qualities of the reach. These characteristics include the areal distribution, width, depth, and velocity of water. At a given channel cross-section, as discharge increases or decreases, width, depth and velocity increase or decrease by amounts determined by the geometry and cross-sectional configuration of the channels.

The areal distribution of water in the partially dewatered reach varies considerably as discharge increases or decreases. Variations are most pronounced in the crest area (A) of the falls where complex channel geometry strongly influences the direction and magnitude of flow. These variations are more regular and less pronounced in areas B and C.

Figure 4-2 shows the approximate flow distribution in the partially dewatered reach at 60,000, 15,000, 10,000, 3,500, and 750 cfs. Photograph 4-2 shows the falls at flows of 2,600 cfs, 5,700 cfs, and 20,000 cfs.

The irregular shape of the riverbed from the crest of the falls to below the gorge produces a variety of effects that strongly influence the nature of the falls. At flows of about 60,000 cfs the entire crest is submerged, the exposed portions of two large bedrock islands are significantly reduced in size, and the lower gorge is filled with water. At lesser flows, larger portions of the islands, ledges, and channels are dry. Below about 8,000 cfs there is not enough water to form waterfalls along the entire length of the main drop, and below about 4,000 cfs, much of the southern channel is dry or contains only shallow isolated pools.

The Reservoir Area

The portion of the river that would be impounded is generally slow-flowing over a gentle gradient of about 5 ft drop per mile. Exceptions to this are the China Rapids, about 2 mi upstream from the falls, and the Burrell Rapids which are another ¾ mi upstream.

Riverbanks in the area proposed for impoundment are generally steep and consist of coarse gravel stabilized by grass and shrubs. The channel appears very stable with little evidence of recent bank erosion.

Sheppard Meadows

The Sheppard Meadows are three small (2.6 to 3.6 acres each) flat, alluvial grassy meadows on the north bank of the Kootenai River 1.4 to 2.5 miles above the site of the proposed dam as shown in chapter three (figure 3-4). These meadows lie along the portion of the channel that would be affected by the reservoir created by the dam. DNRC field investigations showed that the meadows consist of fine-grained river alluvium overlying bedrock. The value of the meadows as wildlife habitat and cultural resource sites leads to concern as to the effects of any rise in groundwater caused by the proposed project. Potential hydrological impacts to the meadows are discussed further in the impacts portions of the Vegetation and Wildlife and Archaeology and History sections of this chapter.

ALTERNATIVE USES OF THE SITE

In a recent inventory by National Park Service consultants of Northern Rocky Mountain geologic sites that would qualify for designation as National Natural Landmarks, Kootenai Falls was given highest priority (Hyndman and Alt 1982). The authors said that the falls area was "An excellent study of well-preserved, Precambrian shallow-water features." They concluded:

> *We most strongly recommend, with no reservations, that the highest priority be placed on the addition of Kootenai Falls to the register of natural landmarks. Its status as one of the largest and most beautiful of the very few surviving waterfalls in the northern Rocky Mountains confers unquestionable regional and probably national significance.*

Classification of the falls as a National Natural Landmark would favor continued use of the area for its present purposes, rather than use for electric generation.

IMPACTS

RESERVOIR AREA IMPACTS

Within the 4.5 mi reservoir area of the project, impacts would result from the alteration of river flow regime, the trapping of sediment in the reservoir, and the erosion of the reservoir banks. Flow velocity would decrease, and the width and depth would increase.

Sedimentation

The effects of trapped sediments in the reservoir would depend in large part upon the amount trapped (table 4-1). The applicant included a sedimentation estimate in its application to FERC (NLI 1978). This estimate erred primarily in the assumption that the proposed Libby reregulating dam would be built on the Kootenai River 10 mi downstream from Libby Dam, and would capture many of the sediments that otherwise would flow into the Kootenai Falls reservoir. Funding for the reregulating project has been withdrawn by Congress and it is uncertain if it ever will be built. Operation of the reregulating dam would reduce the drainage area contributing sediments to the Kootenai Falls reservoir from 1,430 sq mi to 515 sq mi, and probably therefore would reduce the sediment inflow to Kootenai Falls by approximately 65 percent. At this rate the reservoir would be filled to 31 percent of its capacity in 100 years. Most of the impacts associated with reservoir sedimentation would be eliminated. Slower sedimentation rates probably would prevent or greatly delay elevation of the reservoir surface as a result of sedimentation, and the slower accumulation would extend the time before sediments would begin hindering operation.

TABLE 4-1. ESTIMATES OF SEDIMENTATION

	Drainage Area Contributing Sediment (sq mi)	Sediment Deposited Annually (acre feet)	Reservoir Capacity Assumed (acre feet)	Percentage Loss of Reservoir capacity	
				after 50 yrs	after 80 yrs
NLI (1978) Application	515 (assumes reregulating dam built)	7.8	1220	—	—
Allen, A. (1981b,c)	1430	34	3860	44	70
Cartier (1981)	1430	22	3860	29	46

In view of the uncertainty as to whether the reregulating dam is to be built, DNRC requested that the applicant revise its estimate to show how sedimentation would occur if the reregulating dam were not built. This revised analysis indicated that an average of 34 af of sediment would accumulate in the reservoir each year. This would reduce the reservoir capacity by 44 percent (1,700 af) in 50 years. After about 40 years the sediment at the dam would be at an elevation of about 1,980 ft, which is the elevation of the water intake for the turbines. Sediments would then have to be removed to ensure satisfactory operation of the intake or the project would have to be abandoned (Dalby 1981c). Estimates of sedimentation rates are only approximate because of the wide range of events that can have major effects on the process. For example, extensive forest fires or logging can cause increases in the amount of sediment manyfold above the normal. Therefore, the figures above could be half or double the rates that would actually occur.

When sediment accumulations reach a certain level in the upstream end of the reservoir, the level of the water surface would rise. The applicant estimates that after 50 to 80 years of project operation, some relocation of the railroad and highway might be required between 1 mi and 5 mi above the dam (Allen, A. 1981c).

NLI said in its application that dredging or flushing of sediments from the reservoir probably would be necessary to allow efficient flow diversion and project operation after about 40 years (Allen, A. 1981b,c).

The applicant indicated that flushing operations might increase sediment concentrations in discharged water up to 1,800 mg/1 (Allen, A. 1981b and c), which would violate Montana Water Quality Standards. More recently, however, NLI modified its application to say that no flushing or dredging would be done, and the project would be abandoned when sediments hinder operation. However, the uncertainty of the future makes it possible that dredging might be considered at a later date, and for this reason the impacts of dredging are discussed as follows.

Dredging may be performed by mechanical or hydraulic means. Mechanical dredges remove sediments without including significant amounts of water, and therefore keep the material much more compact than hydraulic dredging which removes materials by suction in a 1:4 to 1:5 sediment/water mixture.

Hydraulically dredged sediments have higher water content and consequently greater unit volume than mechanically dredged materials, resulting in greater economic and environmental costs for transportation and disposal. Sediments dredged by hydraulic means generally are transported via pipeline to nearby low lying areas for disposal (Loar et al. 1980). Hydraulic dredging (assuming a 1:4 sediment water mixture and a disposal depth of 10 ft), would require approximately 85 acres of land to store 10 percent of the sediment accumulated over 50 years of project operation. This is about 5 times the space that would be required for the same amount of sediment dredged mechanically, because of the greater water content in hydraulically dredged materials. Mechanically dredged materials can be moved by barge or truck.

Generally, the decision as to which dredging method is better for a given situation depends on the availability of a suitable disposal site. There are no suitable disposal sites in the immediate Kootenai Falls area and dredged materials probably would require transportation to sites some distance away. If it is assumed that the dredging required for the project were restricted to seasonal maintenance of flow diversion structures and removal of some material immediately upstream from the dam, mechanical dredging probably would be preferred. If at some point more extensive removal of materials were undertaken, hydraulic methods probably would be employed.

The environmental impacts of reservoir maintenance by dredging would include increased reservoir turbidity and downstream siltation during dredging operations. Mechanical dredging causes more stream turbidity than does hydraulic dredging. Water quality problems that could result from dredging include the release of sediments contaminated with pesticides and metals. Fine sediments generally have a high affinity for many harmful substances introduced to surface waters by land use. The extent to which this would cause future water quality problems is not predictable.

Sheppard Meadows Impacts

The proposed dam would raise the water surface elevation within the portion of the river channel adjacent to the Sheppard Meadows. This increase in water surface elevation probably would raise groundwater levels in the Sheppard Meadows (Dalby 1981a; 1982).

Hillslope run-off contributions superimposed on this level would result in frequent saturation of the soil throughout the meadows. Without preventive measures, the downstream meadow would be marsh-like at least in the spring and early summer.

One of the major potential impacts of reservoirs is wave erosion of banks and the subsequent sloughing or slumping of soil into the water. Approximately 90 percent of the proposed reservoir boundary is consolidated rock that would not be eroded. The only portions of the shoreline that would be susceptible to such effects are easily eroded fine-grained soil such as that along the edge of the Sheppard Meadows.

IMPACTS TO THE PARTIALLY DEWATERED REACH

Flow Distribution Effects

The applicant proposes to evenly distribute a constant flow of 750 cfs along the crest of the dam (about 750 ft in length). This water would flow across ledge 1 into channel 1 which would transmit the bulk of the flow northwestward (see figure 4-1). A minor amount of flow probably would enter channel 2. At 750 cfs the maximum discharge of channels 1 and 2 at the midpoint (400 ft north of the south bank) would be about 400 cfs. With the exception of minor amounts of water that might enter channel 2 and be transmitted northwestward, most of the crest area and main drop of the falls would be dry at 750 cfs.

DNRC estimated the differences in channel width, depth and velocity for various discharges in the partially dewatered reach.

Within some areas of the reach, average water depths at 750 cfs would be reduced to approximately 2 ft. Pools would be approximately 5 to 15 ft deep. Water in riffles or among bedrock protrusions would be approximately 1 ft deep. The overall reduction in depth of channels would expose much more bedrock than visible at present.

The existing flow variability at the falls would be reduced greatly. As proposed, discharges through the partially dewatered reach would be greater than 750 cfs only when river flow was more than 25,150 cfs, which would be about 25 days/year. Under existing conditions, flow is less than 4,000 cfs only 37 days a year and can vary considerably during a day with peak power releases from Libby Dam (Dalby 1981b).

Sedimentation

Most rivers flowing in channels composed of alluvium (silt, sand, and gravel) gradually move these materials downstream. The building of a dam typically interrupts this flow of alluvium by trapping much of it in the reservoir. The release of water from a dam commonly induces the accelerated erosion downstream of the dam. Immediately below Kootenai Falls, however, the channel is cut into bedrock which would not be quickly eroded. Studies of the Kootenai River, including surveys by the U.S. Army Corps of Engineers near the town of Libby, indicate the trapping of sediment by Kootenai Falls dam would not result in significant degradation of the channel within the dewatered reach or farther downstream, but the reduced flow caused by the project would be insufficient to clear rocks from the channel, which, over a period of years, could result in blockage.

Channel blockage by scree and boulders could result from the decreased flow in the partially dewatered reach. This coarse material enters the channel through rockfall from cliffs along the sides of the channel and, to a lesser extent, from minor tributaries. Powerful currents normally sweep this material downstream (Dalby 1981c).

Icing

Portions of the partially dewatered reach freeze at the present river flows of 4,000 to 40,000 cfs, with as much as 70 percent of the channel surface covered with thick ice. At the proposed 750 cfs maintenance flow, the freezing is likely to be greater. It is possible that in the coldest months of an average winter, icing at a flow of 750 cfs would cover all water in the reach except for the highest velocity areas. If there were a powerhouse malfunction and the entire flow of the river had to be turned suddenly over the dam, the ice break up could cause a jam at some point in the channel with a potential for channel scour and flooding. The magnitude of this danger is uncertain, but could pose a significant problem during cold winters (Kellerhalls and Gill 1973, Smith 1980).

Impacts Downstream from the Outlet Portal

The results of sediment removal by the dam at Kootenai Falls are uncertain. However, the river bottom downstream from the outlet portal is generally coarse, and the removal of additional sediment (beyond the removal of the major load by Libby Dam) could cause further coarsening of the river bottom. This could be detrimental to some types of aquatic organisms, but the magnitude of the effect cannot be known at this time.

Impacts of Abandonment

The ultimate disposition of the proposed dam, if built, would depend upon technology, economics, and the desires of society at the time the project stopped operating. Abandonment of the dam could create a new set of impacts, depending on the amount and distribution of sediment in the reservoir and how it would be controlled after abandonment. The controls that would be adopted and the desires of society at that time cannot be known now.

Seismic Risk

Although western Montana has experienced several damaging earthquakes in historic times, the Kootenai River area has a moderate-to-low seismic risk (HARZA 1980). Earthquake danger is of particular concern when major dams are to be built. In the case of the proposed project, the low dam and small reservoir would preclude any major danger of flooding if the dam were to break or if an earthquake-caused landslide goes into the reservoir.

Impacts on Alternate Uses of the Site

If built, the proposed project would preclude designation of Kootenai Falls as a natural landmark and its consequent use for primary purposes other than power generation. If such a designation were made prior to construction, the project could still be built, because the Landmark designation would not carry with it any site acquisition, management, or enforcement powers. However, the falls would then have to be removed from the Register of Natural Landmarks.

REDUCTION OF IMPACTS

The hydrological effects of the proposed project would cause impacts to archaeology, recreation and aesthetics, aquatic habitats, wildlife and vegetation, economics, water quality, and Indian religion and subsistence. These impacts and the potential for reducing them are discussed in the sections pertaining to these resource areas.

WATER QUALITY

Water quality regulations are among the environmental laws not superseded by the Major Facility Siting Act. The Montana Department of Health and Environmental Sciences (DHES) retains authority over water quality matters, and the following section was prepared by that department (Horpestad 1982).

EXISTING ENVIRONMENT

Water quality of the Kootenai River in the project area is largely determined by the discharges from Libby Dam. Operation of the dam has changed the temperature regime, dissolved gas levels, suspended solids, total phosphorous, and specific conductance, although no water quality standards are being violated. The Kootenai River remains a hard water stream of the calcium carbonate type, having somewhat higher mineral content than is usually found in the intermountain region.

Water pollution discharge from activities such as stream bank alteration, cofferdam placement and removal, and discharge portal construction are subject to the Montana water quality standards under Section 16.20.633(3) which requires that such activities be done in accordance with procedures authorized by DHES. This section of the Montana water quality standards requires that impacts be controlled in a manner prescribed by DHES. The procedures required are designed on a case-by-case basis to reduce impacts on surface water quality to the maximum extent determined feasible by DHES.

IMPACTS

CONSTRUCTION IMPACTS

There would be an increase in sediment due to the disturbance of land from such activities as railroad relocation, clearing, and spoil disposal in the construction area of the proposed plant; construction of access roads, cofferdams, and the creation of project facilities such as the dam, intake structure, powerhouse, access tunnel, and tailrace. Runoff from the disturbed areas and spoil material would deposit sediments in the immediate area and downstream from the development. Additionally, water removed from the diversion tunnels during excavation would contain large quantities of finely crushed rock.

These materials would increase the turbidity and suspended solid levels in the surface waters. The amount of increase depends on the effectiveness of control measures prescribed by DHES and weather conditions during each phase of construction. The increases in downstream turbidity and suspended solids concentrations are impossible to predict precisely. Because of the relatively large flow of the stream, the effects are expected to fall into a range that would not cause serious impacts to stream organisms if control techniques such as settling are used as proposed by the applicant.

Construction activities that result in controllable runoff would create point source discharges to the stream. These discharges are subject to permits from the Water Quality Bureau of DHES, designed to prevent violation of water quality standards.

The water and spoil material from blasting would contain appreciable amounts of nitrogenous compounds, but the large flow of the Kootenai River probably would prevent any instream impacts. These compounds also would require point source discharge permits.

Placement or spilling of concrete in streams and accidental spills of other material would degrade water quality. No major toxicants are expected at the construction site, so it is unlikely such accidental spills would cause major impacts.

OPERATION IMPACTS

Water Temperature

Estimates indicate that reservoir retention time would range from about 23 hours to 2 hours at flows of 2,000 cfs and 25,000 cfs resprectively. The applicant therefore concludes the reservoir would not stratify and any change the impoundment might cause in the existing summer water temperature regime would not be significant (FERC 1981). The applicant also said it is likely the decreased velocity would allow sufficient cooling of surface waters in winter to cause at least a partial ice cover to develop in the project reservoir. After analysis of the data, DHES agrees with these conclusions insofar as they apply to the sections upstream from the dam and downstream from the discharge tunnel. DHES also agrees with the conclusion that the partial ice cover on the reservoir probably would not cause significant water quality impacts.

Analysis performed by an engineering firm hired by the applicant (FERC 1981) indicates that the Montana water quality standard restricting man-caused temperature changes to a 1 degree F maximum increase would not be violated in the partially dewatered reach where such violation would be most likely. After reviewing the analysis, DHES concurs in this conclusion. The allowable decrease is 2 degrees F and the project would not violate the standard. Downstream from the outlet tunnel, the temperature impacts of the project would be insignificant.

Dissolved Gas

FERC (1981) said the applicant plans to inject compressed air into the draft tubes when available flow is less than 4,000 cfs for any unit. Injection of compressed air at these times would allow smoother operation and reduce the potential for rapid expansion of dissolved gas.

DHES' preliminary evaluation of the air injection proposal indicated that Montana water quality standards might be violated. DHES requested additional information, and concluded that modifications were necessary to avoid such violations. In response to the DHES concern, the applicant submitted a proposal for an alternative power plant design that would not require air injection. This proposal became official September 29, 1981, when the applicant notified DNRC that it had changed the design of the underground powerhouse to accommodate five turbine/generators instead of four (Vasile 1981). As a result, Montana water quality standards for dissolved gas would not be violated.

Sedimentation

Much of the sediment normally transported by the Kootenai River would accumulate in the proposed reservoir. Preliminary information from the applicant indicated that flushing or dredging would be required after about 40 years of operation. More recently, however, the applicant officially notified DHES that it "sees no reason to consider flushing or dredging of the reservoir and does not know of any method that can remove the accumulated sediments without violating a water quality standard..." (Sewell 1981). DHES concluded that the rate of sediment accumulation in the reservoir cannot be precisely predicted and that there are no methods that could be used to remove sediment without violating Montana Water Quality Standards.

REDUCTION OF IMPACTS

Flushing and dredging could be prohibited to prevent the violation of water quality standards that would result from such activities.

The chance of impacts from placement or spillage of concrete or other material could be reduced by placing refueling stations and vehicle and hydraulic service areas well away from the river in spill containment areas. The impacts of placing concrete instream generally can be reduced by not performing such work at low flow, although the Kootenai River's relatively large flow might prevent impacts, even if the work is done during low flow. Accidental spills could be reduced by requiring that personnel are aware of the possibility of the damage to water quality and by emphasizing that any violation of Montana water quality standards would result in enforcement action by DHES.

All instream activities would have to be approved by DHES before construction.

DHES could inspect the construction area to be inundated just before scheduled impoundment to ensure that no oil or other potential water contaminants were present in volume sufficient to violate water quality standards.

AQUATIC LIFE AND HABITATS

The section of the Kootenai River that would be affected by the project is one of the most productive and heavily fished stretches of river in Montana. Fishing pressure and catch rates are comparable to those of some of Montana's nationally-acclaimed "Blue Ribbon" trout streams such as the upper Madison, Big Hole, and upper Yellowstone Rivers (Graham 1979a). For this reason and also because the proposed dam could affect aquatic life and habitats far upstream and downstream, effects on game fish populations are one of the primary concerns in evaluation of this project. Since gamefish are part of a complex community of aquatic life, other aquatic plants and animals are also of concern and are discussed below. More detailed information can be found in Robinson (1981a).

EXISTING ENVIRONMENT

Aquatic plants are an important component of riverine ecosystems. Side and backwater areas on the Kootenai River support stands (some of them dense) of Canadian pondweed and water crowfoot. These plants, along with certain types of algae that grow on rocks, have increased in abundance since the completion of Libby Dam, probably because they are no longer being flushed out by flood discharges. Aquatic mosses occur on the surfaces of boulders and bedrock in the falls and upstream, primarily in areas where there is fast current.

Aquatic invertebrates—predominantly insect nymphs but including other forms such as shrimp and worms—live among the bottom rocks or burrow into the river bottom. They are sensitive to change in river bottom characteristics, water quality, water velocity, and water depth. Fish depend on these river bottom organisms as a food source, and the general character of the fish community depends upon the number and type of them available for consumption.

Species composition and numbers of aquatic insects in the river downstream from Libby Dam have changed since the filling of Lake Koocanusa. The original complex of stonefly, mayfly, caddisfly, and true flies changed to become dominated by a few mayfly and true fly taxa. The scarcity of stoneflies because of low oxygen content in the water is a notable feature of the existing Kootenai River between Libby Dam and Kootenai Falls. Stoneflies are apparently more common below the falls, possibly because periodic low oxygen levels in water released from Libby Dam are alleviated by passage over the falls.

The most abundant fish species overall are rainbow trout, mountain whitefish, largescale sucker, and longnose dace. Northern squawfish and peamouth chub are rare above Kootenai Falls but common below. The Kootenai River downstream from Kootenai Falls contains the only known population of white sturgeon in the state. Portions of the Kootenai drainage below the falls contain the only known native rainbow trout populations in Montana. Kokanee occur below the falls during their spawning season.

Figure 4-3 shows sections of the Kootenai River in Montana where fish populations have been studied since 1969. This sampling indicates that the most productive rainbow trout populations in the river are in the Flower-Pipe and the China Rapids-Kootenai Falls sections. The highest mountain whitefish populations were observed in the Jennings and China Rapids-Kootenai Falls sections. The highest populations of rainbow trout and mountain whitefish on the river are believed to be in the China Rapids-Kootenai Falls section. The area just upstream from Kootenai Falls is the most heavily fished section of the river in Montana, due to the abundance of the preferred game fish species, rainbow trout. Overall, it appears that there has been a trend since 1973 toward an increase in both mountain whitefish and rainbow trout throughout the Kootenai River, with a general decrease in average size. The increase in number is probably due to cleanup of two pollution sources on the Kootenai River in Canada, and to the correction of gas supersaturation problems which occurred during the early operation of Libby Dam.

IMPACTS

Construction of the proposed dam at Kootenai Falls would have substantial effects on aquatic life and habitats upstream and downstream from the project area. Some of the most important of these effects are discussed below, and include: alteration of aquatic habitat in the reservoir area and the partially dewatered reach, increased mortality rates for fish moving downstream and consequent effects on the downstream fishery, changes in water quality and fishing pressure, blockage of upstream fish movement, and possible flow reductions in the Kootenai River below Libby Dam during construction. More detailed discussion of these impacts has been presented by Robinson (1981a).

HABITAT CHANGE IN THE RESERVOIR AREA

Impoundment of the Kootenai River by the proposed dam would drastically alter aquatic life and habitats in the reservoir area. It would, in effect, convert about 4.5 mi of riverine environment to a rapid-flow-through reservoir environment, which is quite different from either a river or a storage reservoir. The main difference relates to reduced water velocity, sedimentation of the river bottom, elimination of water level fluctuations, and increased water volume and bottom surface area, as described below.

Reduced Water Velocity

The most important change in the reservoir area would be the reduced water velocity (extending about 4.5 mi upstream from the dam) and the subsequent deposition of silt (see Hydrology discussion). As a result of the reduced velocity and settling of sand and silt, there would be decreased availability of those species of aquatic insects which are the main food for trout and whitefish on the Kootenai River. Insects that crawl over river bottom rocks and are available as fish food would be replaced by burrowing insects that would not generally be accessible to trout. Also, the reduced water velocity and the burrowing nature of the new insect types would greatly reduce the drift of insects within the reservoir. Such drift provides a highly important food source for stream-dwelling trout, and they select and defend territories most suited to intercept it. The new aquatic insect community in the reservoir would be better suited for suckers, which are primarily bottom feeders that suck up bottom mud and separate the food, than for trout.

Unlike storage reservoirs such as Libby Dam, rapid-flow-through reservoirs such as the one proposed do not develop plankton communities usable as a food source for trout. This is because the water velocity, although much slower than that of the unimpounded river, is still too fast to allow planktonic organisims to complete their life cycles within the reservoir.

Changes in water velocity and bottom characteristics would eliminate any spawning habitat for rainbow trout and mountain whitefish that might be in the reservoir area. Rainbow trout are not known to spawn in the portion of the main channel that would be impounded. Spawning habitat quality for most other species also would be reduced by sedimentation.

Increased Water Volume and Bottom Surface Area

The flooding of terrestrial habitat would create approximately 60 acres of new water environment and a greatly increased water volume. Newly-inundated habitat is normally highly productive at first because of the nutrients in the soil and from dead or dying vegetation and new reservoirs commonly experience an initial "boom" in biological productivity. Aquatic insect populations favorable to trout would probably increase on the flooded rocks until habitat was rendered unsuitable by siltation. However, the short water retention time of this reservoir would cause a rapid downriver flushing of organic materials, and the "boom" would be very short-lived if it occurs at all. There also would be increased habitat for some types of fish because of the increased water vloume. Therefore, although the project might cause some initial increase in overall fish productivity, population densities would decrease (more fish spread through a greater volume). Any temporary increase in trout productivity probably would not be reflected in increased trout availability to fishermen because of this decreased density. DNRC examined 10 rapid-flow-through reservoirs in Montana that would be generally similar to the proposed reservoir and found that none had quality self-sustaining trout fisheries.

Constant Water Level

The proposed dam would result in a stable water level in the reservoir area, in contrast to the present situation where water levels and wetted perimeter

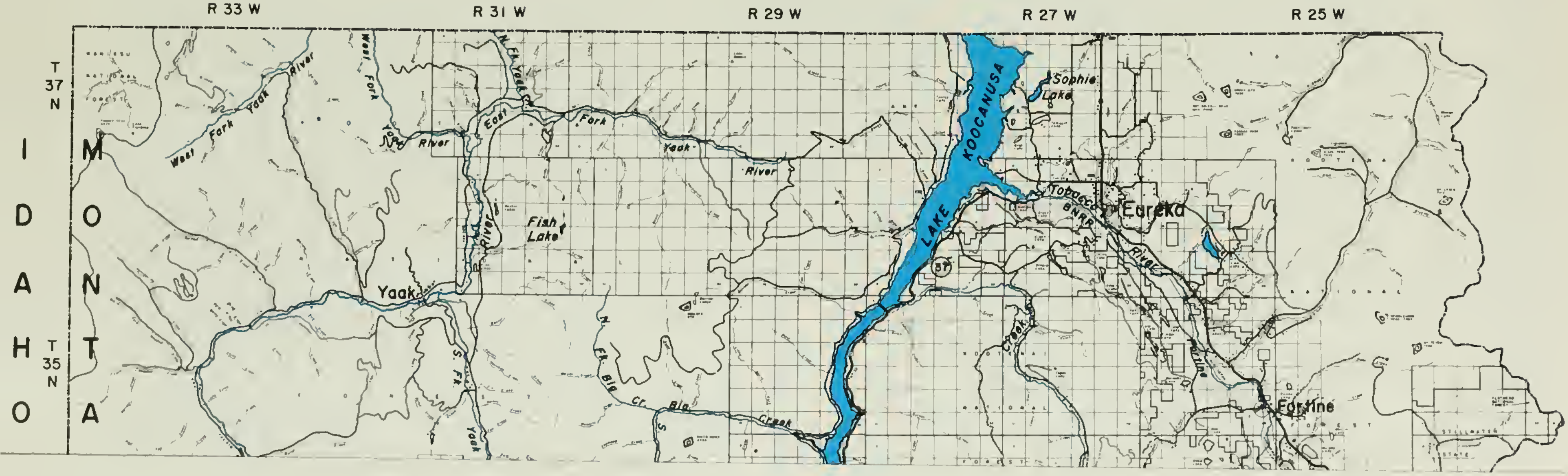


FIGURE 4-3. FISH SAMPLING SECTIONS IN THE KOOTENAI RIVER

1 Jennings section
2 Elkhorn section
3 Flower-pipe section
4 China Rapids-Kootenai Falls section
5 Throops Lake section

Source: DNRC with Information from the Montana Department of Fish, Wildlife and Parks

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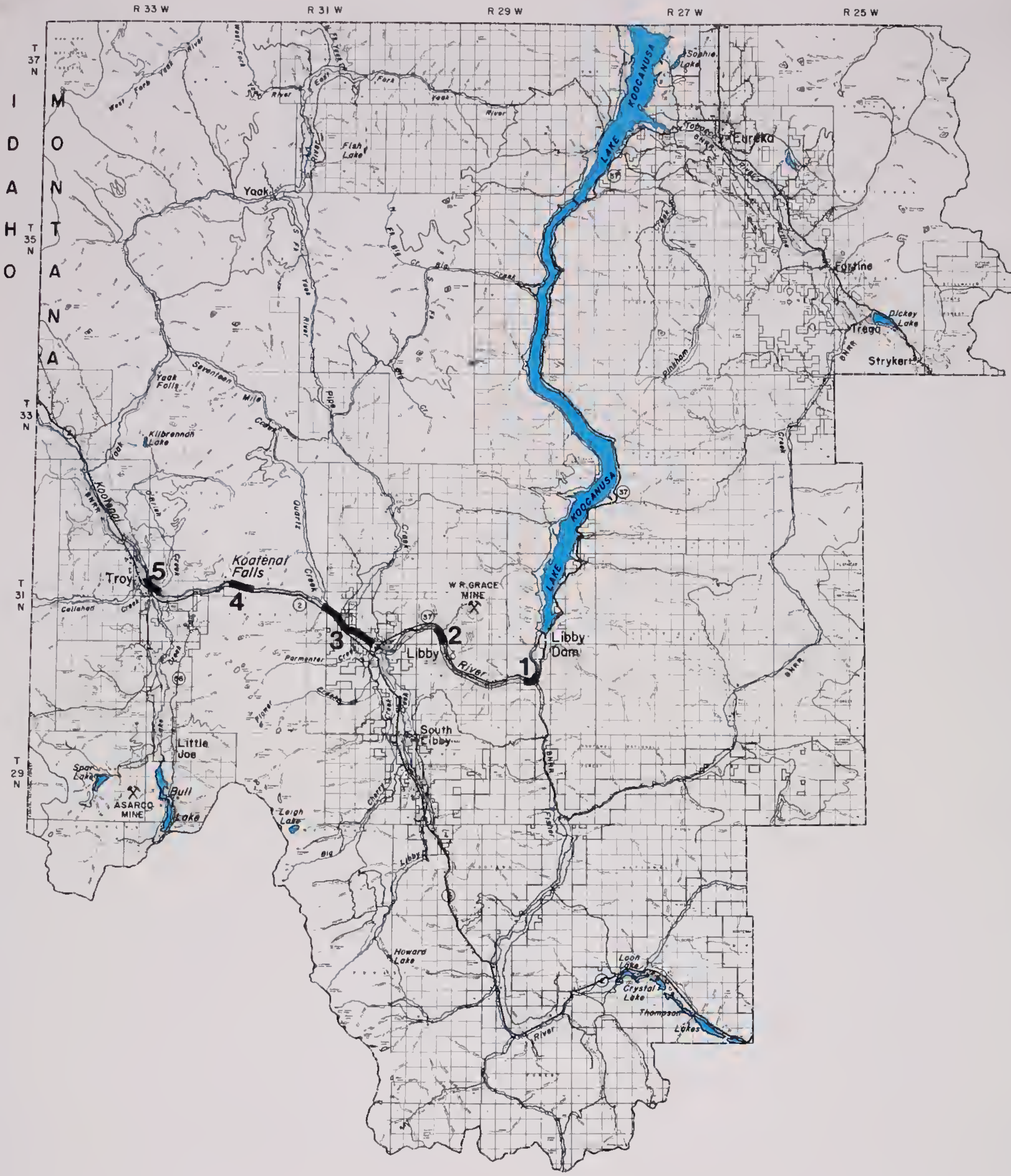

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5 Throops Lake section

Source: DNRC with information from the Montana Department of Fish, Wildlife and Parks

fluctuate widely on a daily basis (DNRC 1979). This change in habitat would allow some aquatic insect populations to increase until sedimentation renders the river bottom habitat unsuitable. Rooted aquatic plants and associated invertebrates probably would increase as a result of the stabilized water level.

HABITAT CHANGE IN THE PARTIALLY DEWATERED REACH

The portion of the river that would be partially dewatered by the project appears to be a better trout fishery than any other portion of the river downstream from the falls (Robinson 1981a). Most trout in the partially dewatered stretch probably arrived over the falls from upstream. The diversion and the barrier created by the dam would curtail this movement into the dewatered stretch, causing a decline in trout populations. This decline would be particularly serious near the base of the dam and in some of the holes just below the main drop. The reduced flows also would virtually eliminate any movement of trout into these areas from downstream. At present, it is likely that some trout swim up into these areas, especially during spawning. The food supply for any trout that do enter the dewatered stretch would be severely reduced by cutting off the invertebrate drift from upstream (because of the dam, the diversion, and the reduced insect productivity and drift within the reservoir), and by the dewatering of a large portion of the Koot Creek gravel bar, which is a major source of aquatic insects in this stretch.

White sturgeon, classified by DFWP as a Class A species of special concern and by the American Fisheries Society as endangered in Montana, are occasionally found in the Kootenai River between the falls and Idaho. The population has declined greatly in recent years in Montana, possibly due to flow regulation by Libby Dam. None was caught in the Kootenai River during two different sampling periods in 1981. Their use of the portion of the river that would be partially dewatered by the project has not been documented. However, in the summer of 1980, divers employed by DFWP saw one white sturgeon in the river at the point where the water from the discharge tunnel would return to the main channel. Populations remain strong in the Kootenai in Idaho and British Columbia (Graham 1981). It is suspected that sturgeon from Idaho and British Columbia spawn or once did spawn just below Kootenai Falls (Graham 1981). Movement in the river has been documented between Kootenai Falls and Bonner's Ferry, Idaho, and from Kootenay Lake upstream into Idaho. However, there is no evidence of recent spawning even in Idaho.

Construction of the proposed dam would preclude the possibility of any future spawning by sturgeon in the dewatered reach since the low flows and reduced depths would prevent their movement into the area and the reduced current would be insufficient for their spawning requirements.

MORTALITY OF FISH MOVING DOWNSTREAM

The quality of the fishery downstream from Kootenai Falls appears to be highly dependent on the movement of trout down over the falls, so mortality of trout going over the dam or through the conduit and turbines of the project is a major concern.

Most spawning by rainbow trout occurs in tributaries, and access to these is important to the survival of Kootenai River trout populations. Tributaries with suitable spawning habitat are much more common upstream from Kootenai Falls than downstream. May and Huston (1979) indicate that the tributaries in the portion of the Kootenai drainage from the reregulating dam site to Kootenai Falls have 36 mi of good stream spawning habitat for rainbow trout, 52 mi of fair habitat, and 47.5 mi of poor habitat. The drainage from Kootenai Falls to the Idaho state line has 8.5 mi of good habitat, 20.5 of fair and .3 of poor. The Kootenai River in Idaho has few trout spawning tributaries, and there is little spawning by rainbow trout in the mainstem Kootenai. Data indicate that downstream drift of trout over the falls is highly important to the maintenance of downstream trout populations. Conservative estimates of annual downstream movement over the Falls range from 2,300 to 3,046 trout over 9 in long (FERC 1980, Robinson 1981a). These estimates probably are lower than actual numbers because they are based on the assumption that the fish population is the same as the angler harvest, whereas in reality the fish population is much higher. Trout movement downstream over the falls may contribute 47-64 percent of the catchable trout downstream of the falls (FERC 1981).

After completion of the project, most fish probably would follow the major flow of water through the conduit rather than go over the dam. Those fish that do pass over the dam would fall approximately 30 feet onto bedrock covered by a depth of water not specified by the applicant. If this water were only a few inches deep, fish falling into it would probably be stunned or killed. Stunned fish would be subject to increased predation from osprey, eagles, and squawfish. However, since only a small proportion of downstream-moving fish would pass over the dam, these increases in mortality would be relatively minor compared to turbine mortalities.

Fish passing through the conduit and turbines could die either from mechanical blows or from pressure-induced injuries. It can be concluded from many studies (Turbak et al. 1981; Bell et al. 1967) that the fewest fish are killed passing through turbines when: (1) turbine speed is low, (2) draft tube pressure is high, (3) clearances between blades are high, and (4) the turbine is running at peak efficiency. With this project, draft tube pressure and blade clearances would be high. Turbine efficiency and speed are not known. DNRC estimates a mortality between 40 and 50 percent for fish larger than 9 inches (Robinson 1981a). Ten to fifteen percent mortality is a reasonable estimate for fish less than 6 inches. This would be a substantial loss to the downstream fishery. According to FERC (1980) estimates, turbine-caused mortality would result in a 27-62 percent decline in the number of catchable rainbow trout downstream from the falls. Mountain whitefish would also be affected, but since considerable spawning occurs in the river channel, the effect on the downstream fishery would not be as great.

BLOCKAGE OF UPSTREAM MOVEMENT

Upstream movement of large rainbow or bull trout from Kootenay Lake over Kootenai Falls for spawning has not been documented, but preliminary evidence indicates such movement may have occurred (Robinson 1981a). Rainbow trout move upstream to spawn in the spring. Libby Dam has altered flow regimes in the river so that the discharges that formerly averaged 33,000 cfs during May and June now are typically 3,000-5,000 cfs. These low flows might allow the upstream passage of large rainbow trout for spawning.

It is also suspected that large rainbow that spawn in Callahan Creek (near Troy) and the Yaak River originate from Kootenay Lake. The Yaak River, Callahan Creek, and Lake Creek (near Troy) also support fall spawning runs of kokanee upstream from Kootenay Lake in British Columbia.

The falls may allow upstream movement of large trout, but the proposed 30-ft-high dam would prohibit fish passage, preventing any establishment of future spawning runs upstream of the falls.

DOWNSTREAM EFFECTS ON WATER QUALITY

Increased sediment loads caused by construction probably would decrease productivity of aquatic insects and fish downstream of the dam during construction. Libby Dam's elimination of flood flows could aggravate the problem because of the reduced capacity to flush sediments out. Accidental spills of petroleum products could result in fish kills of unknown magnitude. Other toxic chemicals, including harmful nitrate and phosphate compounds released during blasting of the tunnel, probably would not be large enough to cause widespread damage to the fisheries. Small, localized fish kills would be possible, however.

Turbines used in the proposed project are not likely to cause gas supersaturation problems. However, diversion of most of the river's flow through the turbines would eliminate the present ameliorating effect of the falls on gas supersaturation or subsaturation of water caused by Libby Dam. The water from Libby Dam occasionally has gas supersaturation levels high enough to be dangerous to fish, due primarily to discharge over sluices. The falls tends to reduce these high gas levels, so the proposed dam could extend the supersaturation problem many miles downstream. When water from Libby Dam is subsaturated, Kootenai Falls tends to increase dissolved oxygen levels resulting in more insect species—particularly stoneflies—below the falls than above. The number of insect species below the falls might be reduced if the proposed dam were to extend the low oxygen levels downstream from the falls. Any such decrease in insect life could adversely effect fish populations.

As discussed in the hydrology and water quality sections above, dredging and abandonment would result in greatly increased sediment loads in the river downstream, which could have important adverse impacts on aquatic life of the river all the way downstream to Kootenay Lake in Canada.

EFFECTS OF FLOW REDUCTION

There might be times when flows from Libby Dam would be reduced to allow construction in the channel at Kootenai Falls. The applicant has no plans to request such flow reductions, but it is possible that an unforeseen situation such as an emergency during construction could require reduction of flow to 3,000 cfs or below. This could seriously affect the entire river down to Kootenay Lake by stranding fish eggs, young trout, and aquatic invertebrates on the shore, depending on the season, and the duration and magnitude of flow reduction. Such flow reduction also could adversely affect seasonal fish migrations into and out of tributaries.

EFFECTS OF CHANGED FISHING PRESSURE

The influx of construction workers could increase fishing pressure on the river, but the river is large and productive enough to reduce the likelihood of serious long-term damage. However, an increase in fishing pressure could make it necessary for DFWP to institute special regulations and increase law enforcement efforts in order to sustain the quality fishery.

REDUCTION OF IMPACTS

There are measures that could reduce some of the impacts on aquatic life. These measures would be effective only if any benefits they provide are protected against future degradation. Definitive recommendations for reduction of impact cannot be made without additional study, and would require consultation with DFWP, USFWS, Idaho Department of Fish & Game, and British Columbia Ministry of Environment.

1) The project could be designed and operated at a reservoir elevation of 1,990 ft instead of the proposed 2,000. This measure would result in considerably less damage to the fishery. At 1,990 the reservoir would be 2.3 mi long as compared to approximately 4.5 mi for the proposal. Therefore, 2.2 mi of river would be spared the impacts of inundation. Furthermore, the 2.3 mi that would still be inundated would be affected less at 1,990 than at 2,000 because water velocities would be greater. The upstream mile of pool would still be very river-like and much the same as it is now at high flows (20,000 cfs and above). However, there would still be some loss of invertebrate productivity at 1,990, and the reservoir would still be poor trout habitat. The smaller capacity of the reservoir would be filled with sediment sooner than if it were at 2,000 ft.

2) In order to maintain the fishery downstream of the dam, the applicant could design turbines and operate the project in such a manner as to minimize turbine-related mortalities of adult and juvenile fish. However, there is a limit to the degree to which fish passage (particularly adult fish) can be accommodated. This measure probably would do little to reduce impacts to the partially dewatered stretch.

3) In order to further reduce losses to the downstream fisheries, turbines could be periodically shut off during the period of maximum downstream fish movement, and the entire flow allowed to pass over the falls. There could be agreements to ensure that instantaneous low flow over the dam and through the partially dewatered reach would never fall below 2,000 cfs. Exact times of trout downstream movement would have to be determined before project operation begins.

Both upstream and downstream movement into the partially dewatered reach could be improved by increased flow over the dam. However, there would still be reduced movement into both the partially dewatered stretch and areas farther downstream. Discharge patterns might have to be adjusted to improve downstream fish movement as monitoring gathers more data on fish movement and the environmental factors that affect it in the Kootenai River.

4) In order to reduce mortality of fish passing over the dam, a pool could be required at the base of the dam to cushiom the fall.

5) Fisheries losses in the reservoir could be reduced if, along with a reservoir level of 1,990 ft, the shoreline and riverbed were recontoured with rock from the tunnel excavation. If the reservoir were at an elevation of 1,990 ft, constrictions could be constructed in at least the upper 1 mi to increase water velocities and improve invertebrate habitat in that portion. This measure would not be effective at a 2,000 ft reservoir elevation. Shoreline recontouring could be done in a manner consistent with wildlife habitat restoration goals. The rock from the tunnel would have to be disposed of anyway, so this measure would save the cost of off-site disposal. The net cost of this measure would be small.

6) DFWP has negotiated and will continue to negotiate with the Corps of Engineers to obtain flow regimes from Libby Dam to benefit fisheries in the downstream Kootenai River and reduce the fishery impacts from that dam. The studies necessary to determine the best procedures have not been completed, but DFWP may in the future request flows that would benefit trout populations and aid in the recovery of white sturgeon populations in Montana. NLI's construction or operation could be required to not limit or interfere with these negotiations.

7) Blockage of movement of large trout up over Kootenai Falls could have major implications for the fishery in the Kootenai drainage from Libby Dam downstream to Kootenay Lake in British Columbia. The impact might be reduced through installation of a fish ladder, although a fish ladder would be expen-

sive (on the order of $500,000) and its cost-effectiveness cannot be estimated based on present data.

8) NLI could be required to increase flows over the dam when gas levels in the water downstream from the falls are either damagingly low (below 90 percent saturated) or damagingly high (above 110 percent saturated). Gas levels should be monitored above and below the falls to determine when problems exist and increased flows over the dam are necessary to correct the problem.

COMPENSATING FOR UNAVOIDABLE IMPACTS

Even if the measures proposed above were entirely successful, there would still be a net fishery loss as a result of the project. The following measures are possible means of compensating for these losses.

1) The applicant could compensate for net losses of downstream-moving fish by improving the trout habitat downstream from the outlet portal. The cheapest way to do this would be to improve and increase rainbow trout spawning habitat in tributary streams below the falls. This tributary improvement would cost approximately $30,000, with yearly maintenance of $2,000.

2) Another means of improving downstream fishery would be construction of an artificial spawning channel. It is difficult to estimate the cost of a spawning channel, but it could cost on the order of $1,000,000 with annual maintenance of $10,000 or more.

3) Planting of trout from wild, genetically suitable brood stock would help compensate for fish losses, although results of DNRC's recreational survey indicate that 84 percent of fishermen interviewed felt that stocking of catchables would not be an acceptable substitute for the existing wild trout fishery. A stocking program could cost $50,000/year.

4) The loss of fishery through impoundment and dewatering could be partially compensated for by improvement of fisherman access downstream of the project or by purchase of fishing waters elsewhere. Provisions could be made to protect these waters permanently for their intended purpose. Also, the quality of the fishery in the remaining running portions of the Kootenai River could be protected through procurement of flow reservations in Kootenai River tributaries. This would ensure adequate spawning flows for the future. Location of all purchases or reservations could be determined in consultation between DFWP and DNRC and all such action could be finalized before construction was allowed to begin.

5) The loss of potential white sturgeon habitat within the dewatered reach could be partly compensated for if the applicant were to support any future white sturgeon recovery program that might be implemented.

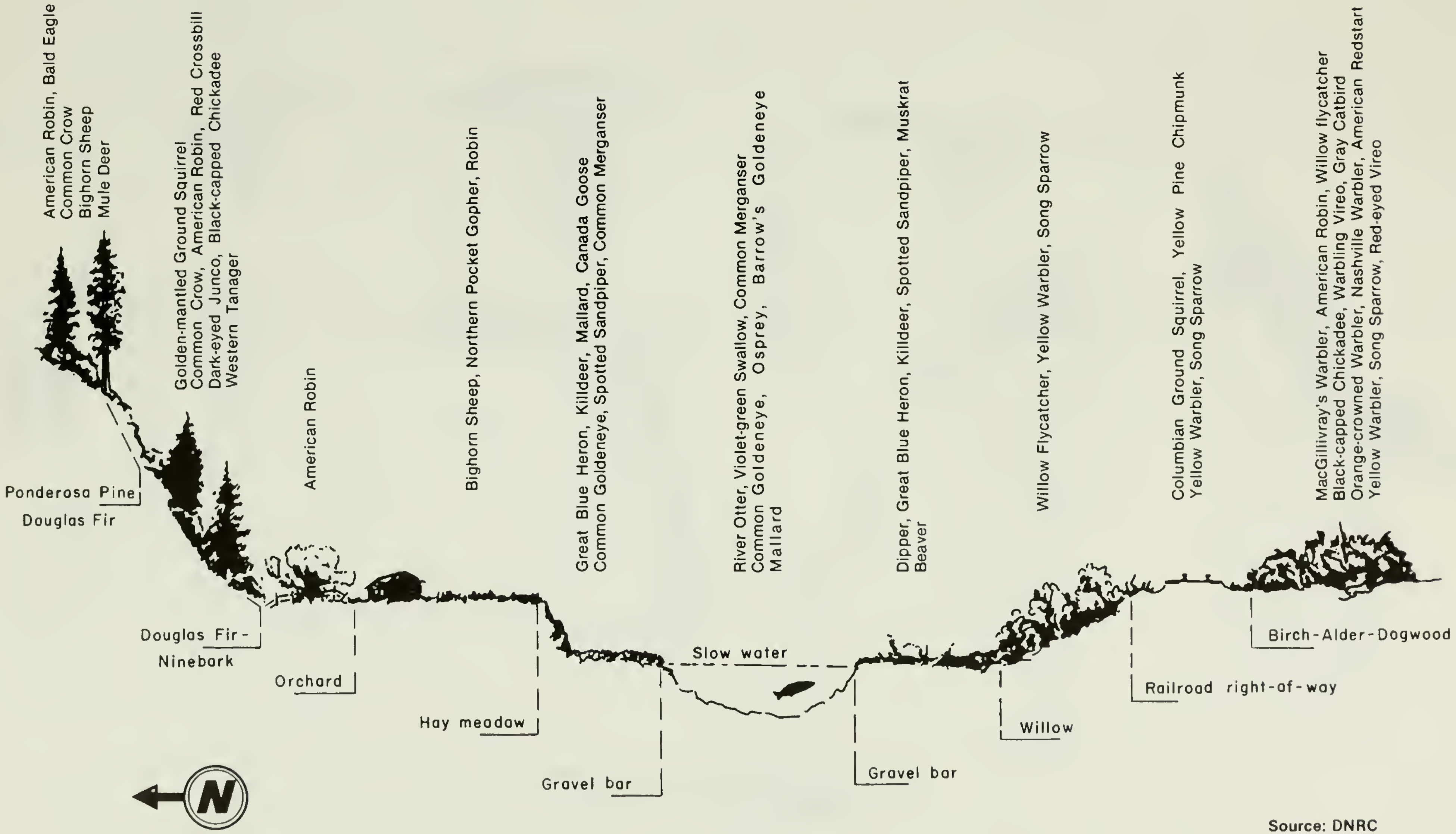
VEGETATION AND WILDLIFE

EXISTING ENVIRONMENT

Vegetation on south-facing slopes in the project area is generally dominated by open Douglas-fir and ponderosa pine forests with undergrowth of ninebark, serviceberry, Rocky Mountain maple, and mock orange. Open grassy parks and rocky cliffs also occur on these slopes. The wetter north-facing slopes are characterized by denser forests dominated by Douglas fir, western larch, and western red cedar. Riparian vegetation forms a narrow band along the river's edge where moisture and soils are suitable. Black cottonwood is the dominant deciduous tree species in these riparian strips, and there is undergrowth of dense shrubbery (including paper birch, mountain alder, and willows) in many places. Scattered stands of mixed coniferous/cottonwood forests grow along the river throughout the project area. There are small grassy meadows (resulting from clearing of the forest canopy) on river terraces along the north and south shores within the project area. The river and falls, together with rocky shores and gravel bars, provide habitat for water-related wildlife species. Figure 4-4 shows the plant associations, wildlife habitat characteristics, and distribution patterns of selected vertebrates among habitats at three representative river canyon cross-sections within the project area. Further information on vegetation and wildlife in the project area is available in Nichols (1981 and 1982) and in DNRC's mapping study (DNRC 1980b).

FIGURE 4-4. DISTRIBUTION OF VERTEBRATE SPECIES AMONG HABITATS AT THREE CROSS-SECTIONS IN THE PROPOSED PROJECT AREA

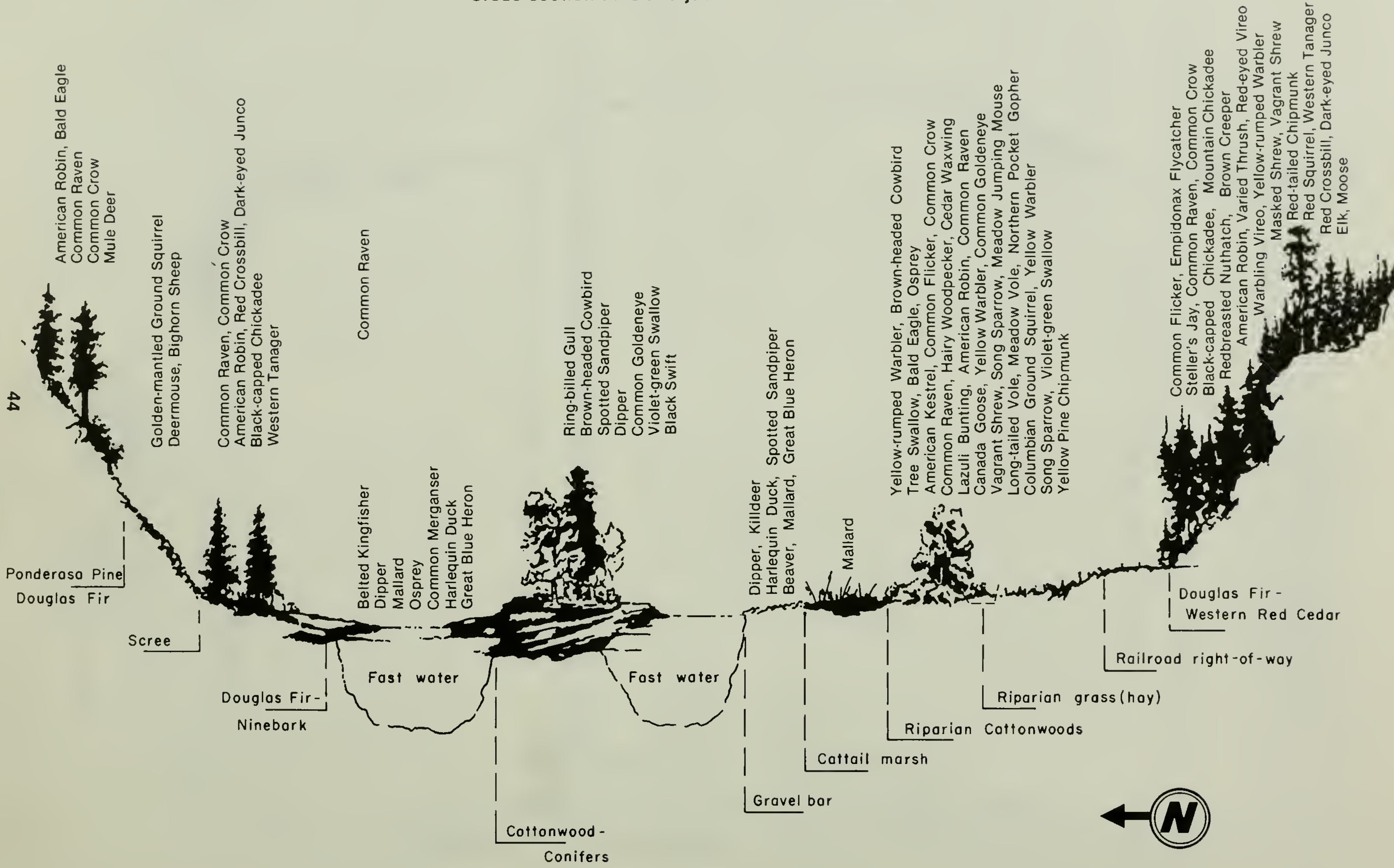
Cross section above falls at Sheppard Meadows


American Robin, Bald Eagle
Common Crow
Bighorn Sheep
Mule Deer
Golden-mantled Ground Squirrel
Common Crow, American Robin, Red Crossbill
Dark-eyed Junco, Black-capped Chickadee
Western Tanager
American Robin
Bighorn Sheep, Northern Pocket Gopher, Robin
Great Blue Heron, Killdeer, Mallard, Canada Goose
Common Goldeneye, Spotted Sandpiper, Common Merganser
River Otter, Violet-green Swallow, Common Merganser
Common Goldeneye, Osprey, Barrow's Goldeneye
Mallard
Dipper, Great Blue Heron, Killdeer, Spotted Sandpiper, Muskrat
Beaver
Willow Flycatcher, Yellow Warbler, Song Sparrow
Columbian Ground Squirrel, Yellow Pine Chipmunk
Yellow Warbler, Song Sparrow
MacGillivray's Warbler, American Robin, Willow flycatcher
Black-capped Chickadee, Warbling Vireo, Gray Catbird
Orange-crowned Warbler, Nashville Warbler, American Redstart
Yellow Warbler, Song Sparrow, Red-eyed Vireo
Ponderosa Pine
Douglas Fir
Douglas Fir-
Ninebark
Orchard
Hay meadow
Gravel bar
Slow water
Gravel bar
Willow
Railroad right-of-way
Birch-Alder-Dogwood
N

Source: DNRC

FIGURE 4-4. (CONTINUED)

Cross section at island just below Kootenai Falls


American Robin, Bald Eagle
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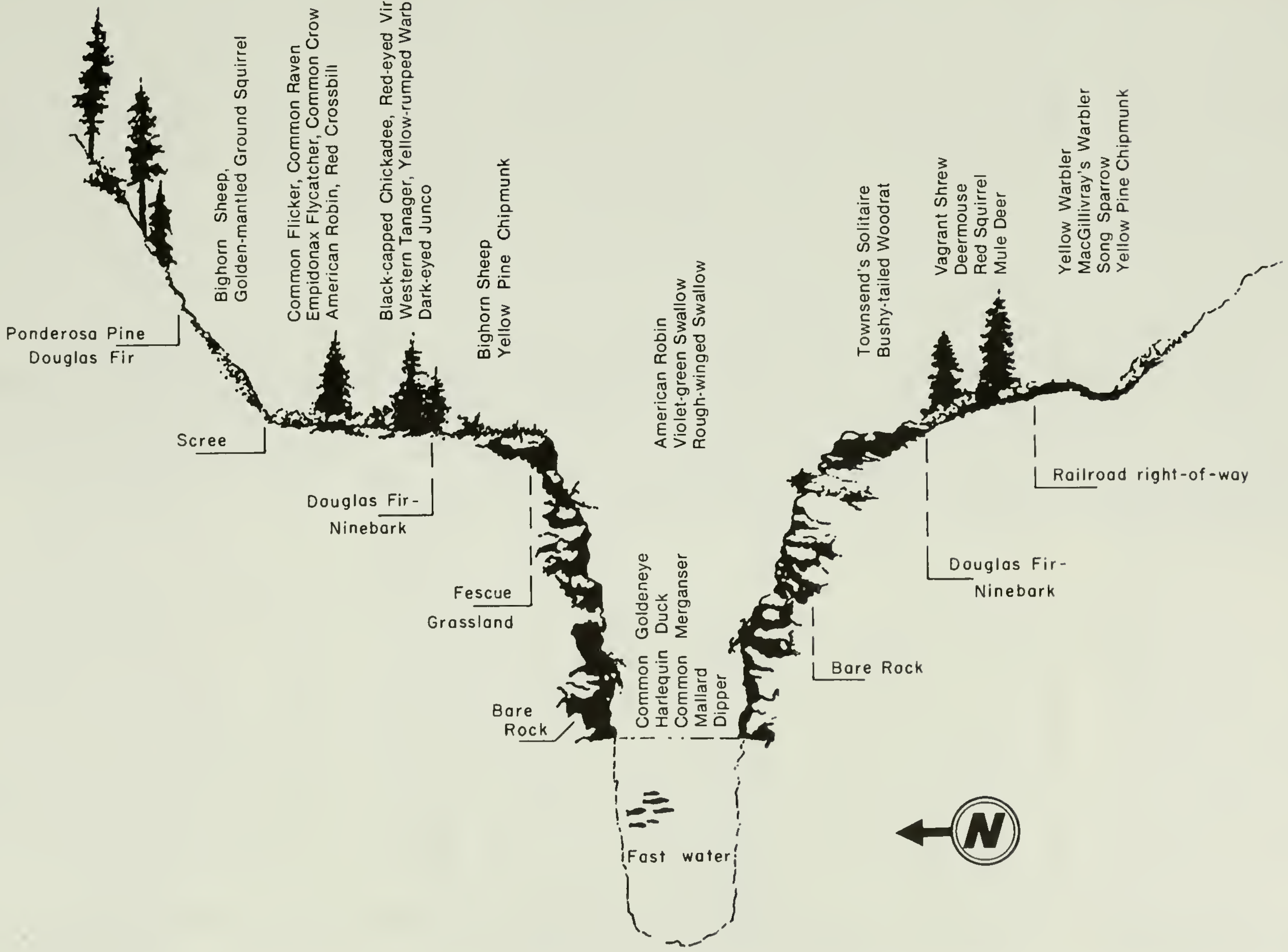
Deermouse, Bighorn Sheep
Common Raven, Common Crow
American Robin, Red Crossbill, Dark-eyed Junco
Black-capped Chickadee
Western Tanager
Common Raven
Belted Kingfisher
Dipper
Mallard
Osprey
Common Merganser
Harlequin Duck
Great Blue Heron
Ring-billed Gull
Brown-headed Cowbird
Spotted Sandpiper
Dipper
Common Goldeneye
Violet-green Swallow
Black Swift
Dipper, Killdeer
Harlequin Duck, Spotted Sandpiper
Beaver, Mallard, Great Blue Heron
Mallard
Yellow-rumped Warbler, Brown-headed Cowbird
Tree Swallow, Bald Eagle, Osprey
American Kestrel, Common Flicker, Common Crow
Common Raven, Hairy Woodpecker, Cedar Waxwing
Lazuli Bunting, American Robin, Common Raven
Canada Goose, Yellow Warbler, Common Goldeneye
Vagrant Shrew, Song Sparrow, Meadow Jumping Mouse
Long-tailed Vole, Meadow Vole, Northern Pocket Gopher
Columbian Ground Squirrel, Yellow Warbler
Song Sparrow, Violet-green Swallow
Yellow Pine Chipmunk
Common Flicker, Empidonax Flycatcher
Steller's Jay, Common Raven, Common Crow
Black-capped Chickadee, Mountain Chickadee
Redbreasted Nuthatch, Brown Creeper
American Robin, Varied Thrush, Red-eyed Vireo
Warbling Vireo, Yellow-rumped Warbler
Masked Shrew, Vagrant Shrew
Red-tailed Chipmunk
Red Squirrel, Western Tanager
Red Crossbill, Dark-eyed Junco
Elk, Moose
Ponderasa Pine
Douglas Fir
Scree
Douglas Fir-
Ninebark
Fast water
Cottonwood-
Conifers
Fast water
Gravel bar
Cattail marsh
Riparian Cottonwoods
Riparian grass (hay)
Railroad right-of-way
Douglas Fir-
Western Red Cedar
N

FIGURE 4-4. (CONTINUED)

Cross section near footbridge



IMPACTS

A few of the many plant and animal species and habitats found in the project area were singled out in DNRC's analysis because of their relative value and/or vulnerability. Relative value was assessed according to the extent of human interest or use, scientific interest or value, recreational or visual appeal, rarity, and special classification as game or endangered species. Relative vulnerability was determined on the basis of how likely the project was to significantly affect populations or habitats. Species, species groups, or habitats with both high value and vulnerability were designated as special concerns and received the most attention during this analysis. These special concerns, together with a summary of probable impacts and possible mitigation, are described in table 4-2. The following discussion presents more information on impacts to the four major concerns considered most significant in this analysis. Additional information on these and other species and habitats has been presented in Nichols (1982).

EFFECTS ON THE CORPS OF ENGINEERS REPLACEMENT HABITAT

A total of about 24,000 acres of land was inundated by Lake Koocanusa, including about 12,440 acres classified by DFWP as big game winter range. Approximately 3,500 acres of this was considered bighorn sheep range (Brown 1979), including most of the winter and spring range of the Ural-Tweed bighorn herd on the west-facing mountain slopes along the Kootenai River. The Ural-Tweed herd suffered a population decline of about 90 percent following the filling of Lake Koocanusa, primarily because it lost most of its winter-spring range (Brown 1979). The decline of this herd is of special concern because it is the only remaining native herd in the Kootenai drainage in Montana (Brown 1981b). As compensation for these losses, Congress authorized $2,000,000 for the Corps to purchase up to 12,000 acres of wildlife grazing lands to be transferred to DFWP for management. However, the funds only purchased 2,456 acres, including 1,417 acres north of Eureka, 932 acres on the west Kootenai Bench northwest of Eureka, and 107 acres along the north bank of the Kootenai River in the project area, including the Sheppard Meadows and adjacent rocky terraces (see figure 3-4 and table 4-3). It was intended at the time of purchase that this land would be managed to improve its suitability as range for bighorn sheep and deer. The objective of the DFWP management plan is "to maintain the Meadows in an open and dry condition and improve sheep use of the Meadows" through management activities including control of shrub encroachment, seeding of alfalfa, and establishment of travel corridors through stands of conifers between the meadows and upslope security areas (Brown 1982). Concern has arisen because of the possibility that the proposed Kootenai Falls dam would reduce the present value of the land for its intended use and preclude future management intended to increase habitat suitability. Any deterioration of this land as a result of the proposed project would partly negate the already-insufficient attempt to compensate for losses caused by Libby Dam.

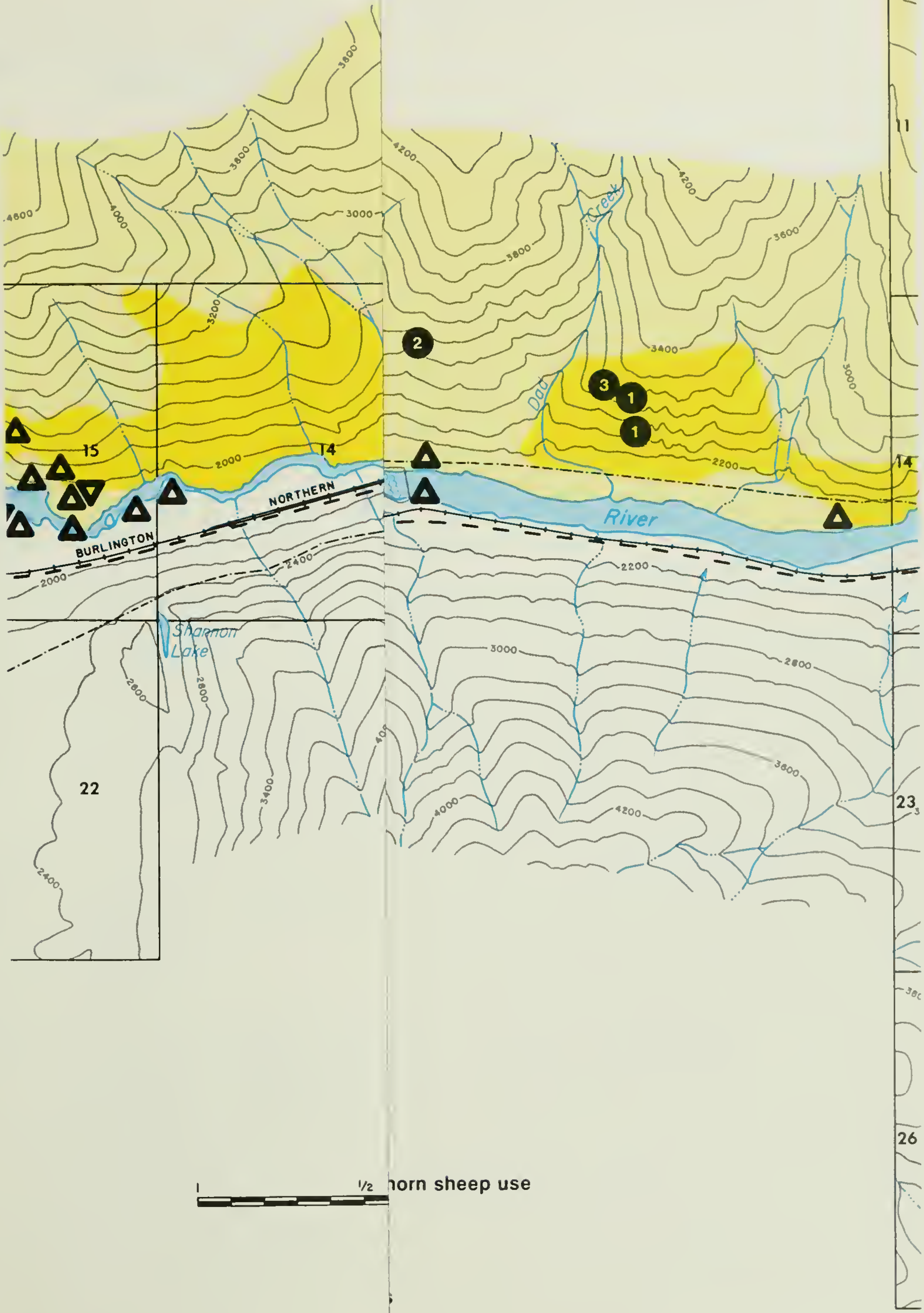
TABLE 4-3. PHYSICAL CHARACTERISTICS OF THE SHEPPARD MEADOWS

	Distance above Dam site	Area (acres)	Maximum elevation (ft MSL)	Minimum elevation (ft MSL)
Downstream meadow	7,190 to 8,370	2.6	2,006	1,994
Middle Meadow	9,660 to 10,750	3.6	2,014	1,998
Upstream Meadow	11,770 to 13,100	2.8	2,010	2,000

Actual inundation within the 107-acre mitigation tract would be about 13 acres at a flow of 15,000 cfs (Nichols 1981), although much of this area would be rocky shoreline rather than vegetated land. Also of concern is the area of land within the Sheppard Meadows that would be affected by elevated groundwater and saturated soils (figure 4-5). In the meadows themselves, about 1.4 acres of land (including about 0.2 acres of grassland) would be inundated or subjected to groundwater within 2 ft of the surface due to bank recharge from the proposed reservoir (Elliott 1982). An additional 1.5 acres would have a depth to groundwater of between 2 and 4 ft. Sediment accumulation in the reservoir would eventually increase water levels above those predicted by the applicant, therefore affecting more land (Dalby 1981a, 1981c).

Groundwater levels would be increased further by the contribution of rainfall and slope runoff, and the

THE VICINITY OF KOOTENAI FALLS



horn sheep use

rom the Montana Department of Fish, Wildlife and Parks

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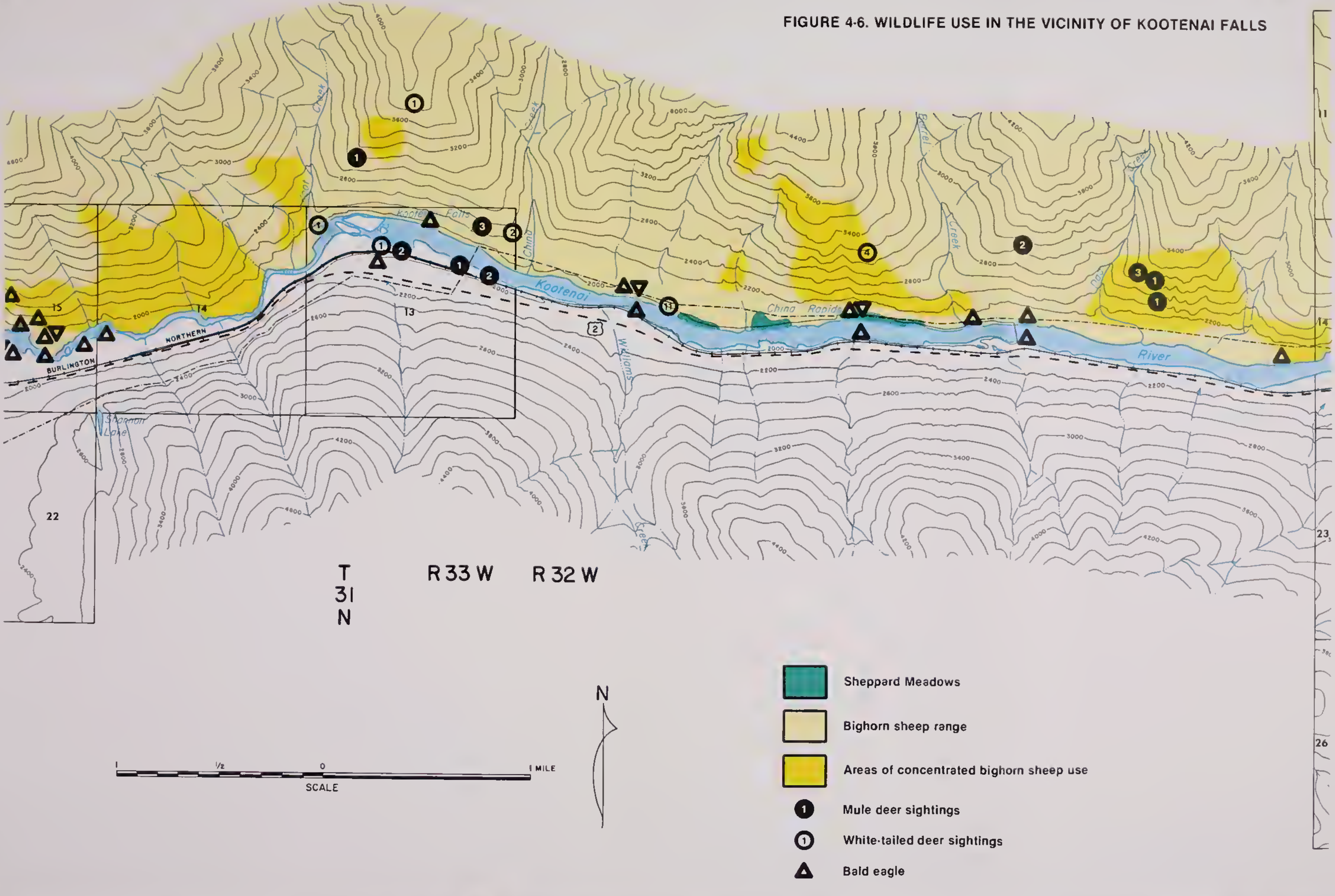
FIGURE 4-6. WILDLIFE USE IN THE VICINITY OF KOOTENAI FALLS



Source: DNRC with information from the Montana Department of Fish, Wildlife and Parks

TABLE 4-2. WILDLIFE SPECIES, SPECIES GROUPS, OR HABITATS OF SPECIAL CONCERN IN THE KOOTENAI FALLS PROJECT AREA.

Species, species groups, or habitats of concern	Description	Expected project-related impacts	Possible measures for reducing impacts and their effectiveness	Severity of probable net/ unavoidable impact (assuming that impact reduction measures listed are followed)[1]
Corps of Engineers compensation land[2]	Consists of 106.9 acres of the former Sheppard property (see Map "Wildlife Areas") which were purchased as compensation for habitat losses caused by Libby Dam, to be managed as grazing lands for deer and bighorn sheep. Includes three abandoned pastures known as the "Sheppard Meadows."	A portion of this land would be inundated by the reservoir and additional acreage would be affected by high groundwater levels. The exact area affected depends upon the reservoir elevation. This would preclude or severely limit the potential of the land for its intended purpose, but more importantly it would negate the effort to compensate for losses caused by Libby Dam.	A. Lower reservoir elevation (very effective for the first few feet below 2,000 ft msl). B. Reduction of groundwater effects (costly but could restore some of habitat lost).	Even with impact reduction measures, there would still be a net loss of compensation land. Any losses of this land are considered highly important, since only one acre was acquired for each 10 acres lost by inundation under Lake Koocanusa.
Riparian tree and shrub habitats[2]	Overstory of black cottonwood with some conifers; understory of various shrubs including paper birch, mountain alder, and willow. Located mainly on the south bank of the river immediately above the dam site. Provides important habitats for a large number of wildlife species.	Clearing, inundation, and railroad relocation would remove 14.4 acres of vegetation from the project area.	A. Lower reservoir elevation (very effective for the first few feet below 2,000 ft msl). B. Reclamation of south bank (as proposed by the applicant, only 11 acres would be reclaimed, and the overstory would not be restored for decades). C. Performance bond (this would ensure speedy reclamation of habitats lost).	At least 14.4 acres would be lost until full reclamation could be achieved (probably 30 years or more), and 3.4 acres would be lost permanently.
Coeur d'Alene Salamander[3] (*Plethodon vandykei idahonesis*)	Found in moist seeps on steep moss-covered rocky cliffs near proposed access tunnel. This subspecies is rare in Montana and has a restricted range.	Possible degradation of habitat due to excavation of access tunnel and interference with water flow over cliff faces as a result of construction of tunnel and powerline bus. Severity of impact depends upon exact location of access tunnel.	A. Education program (would be effective in pointing out habitat areas where special care should be taken during construction).	Probably minor
Harlequin Duck[2,3] (*Histrionicus histrionicus*)	A small population (3 to 8 adults) uses the falls for breeding, feeding and loafing habitat. Requires swift, turbulent water for feeding and quiet backwaters for brood rearing.	Loss of feeding, loafing, and brood-rearing habitat due to impoundment; displacement due to construction activity at head of falls.	There are no known measures that could avoid or reduce the impacts of Kootenai Falls.	Population would probably be permanently eliminated from the project area.
Other waterfowl and water birds	Most common species are mallard, common goldeneye, common merganser, Canada goose, great blue heron, belted kingfisher, spotted sandpiper. Quiet water between falls and China Rapids is important wintering area for common goldeneye.	Nesting and loafing habitat would be reduced for some species, but this loss could be offset by increased brood-rearing habitat. Icing over of reservoir, if it occurs, would reduce the amount of available habitat.	A. Lower reservoir elevation (would be only slightly effective). B. Reclamation of south bank (very effective if sheltered coves created along shore). C. Install nest boxes (inexpensive but of limited effectiveness).	Probably minor, possibly beneficial.

TABLE 4-2. (CONTINUED)

Bald Eagle[3] (Haliaeetus leucocephalus)	Although no nest sites are known near the project area, 2-3 birds winter each year along the proposed reservoir. Cottonwoods and Douglas fir within 50 ft of the river receive the most use for perching, mostly along the north shore. Classified as endangered in Montana.	Loss of perch trees due to clearing and inundation; disturbance by construction activities and the presence of human activity; reduced food supply because of decreased fish availability; loss of feeding areas as a result of freeze-over of the reservoir and dewatered reach; illegal shooting.	A. Retention of trees (very inexpensive, but of limited effectiveness). B. Educational program (could be quite effective if carried out properly). C. Restriction of firearms (moderately effective). D. Increased wildlife law enforcement (very effective).	Probably minor but possibility of significant loss.
Osprey[3] (Pandion haliaetus)	Known nest site near Throops Lake 2 miles below the falls; probable nest site south of China Rapids. Use the stretch of river between the falls up to and including China Rapids for feeding during the breeding season.	Loss of perch trees due to clearing and inundation; disturbance by construction activities and the presence of human activity; reduced food supply because of decreased fish availability; illegal shooting.	Same as for bald eagle.	Same as for bald eagle.
Dipper (Cinclus mexicanus)	Feed on aquatic insects among shoreline rocks and gravel, especially near falls and rapids. Kootenai Falls and China Rapids are important wintering areas.	Elimination of feeding habitat by inundation, dewatering, and icing of shorelines.	A. Increase discharge over dam (slightly effective). B. Reclamation of south bank (could be slightly effective if rocky shorelines created along upper end of pool).	Long-term loss of breeding and wintering habitat (but would not eliminate population altogether).
Mule deer and White-tailed deer (Odocoileus hemionus and O. virginianus)	Low-density use areas are found on north bank of river; use Sheppard Meadows regularly.	Construction-related displacement; increased stress; inundation of habitat; illegal shooting.	A. Lower reservoir elevation (very effective for the first few feet below 2,000 ft msl). B. Reduction of groundwater effects (costly but could restore some of habitat lost). C. Reclamation of south bank (moderately effective). D. Educational program (moderately effective). E. Restriction of firearms (moderately effective). F. Increased wildlife law enforcement (moderately effective).	Probably minor
Bighorn sheep[2] (Ovis canadensis)	See text	Construction-related displacement; increased stress, inundation of habitat; illegal shooting; reduction in number of hunting permits issued (see text).	Same as for white-tailed deer plus: G. Limitation of recreation development (slightly effective). H. Closing of footbridge (slightly effective). I. Bussing of workers (slightly effective).	Probably slight to moderate. Could result in reduction in number of hunting permits issued.
Semi-aquatic mammals	Includes beaver, muskrat, and river otter, which occur in very low densities in project area.)	Could be beneficial effect once habitat restoration is accomplished.	A. Reclamation of south bank (could be very favorable to muskrat).	Probably beneficial

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[1] Net unavoidable impacts are discussed in the text under "Compensation."

[2] See text for further discussion.

[3] Classified by DFWP as a species of special concern (Flath 1981).

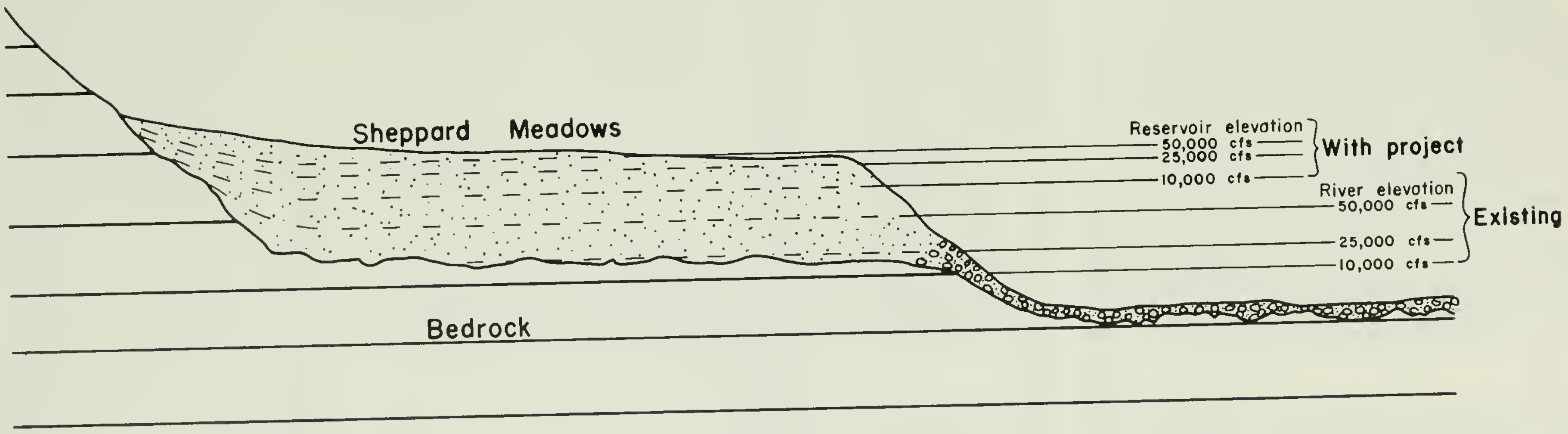


FIGURE 4-5. GROUNDWATER LEVELS IN THE SHEPPARD MEADOWS WITH AND WITHOUT THE PROJECT (GENERALIZED CROSS SECTION)

Source: DRNC

area of land affected would increase. One week of average springtime precipitation would increase the amount of land inundated or having groundwater within 2 ft of the surface to about 3.5 acres (including 1.2 acres of grassland). An additional 1.5 acres would have a depth to groundwater of between 2 and 4 ft. The springs and wet sites within the meadows would be expanded by the increased groundwater levels. Extended periods of above-average rainfall could result in saturation of most of the meadow area for at least part of the year (Elliott 1982, Dalby 1982). The effects of inundation and increases in groundwater levels would be greatest in the downstream meadow.

Changes in soil moisture would alter existing plant communities in the meadows and limit options for future management to improve wildlife range. Conifers and apple trees would probably be killed where groundwater levels are within 4 ft of the surface (Elliott 1982). Marshy vegetation, probably dominated by cattails, sedges, and rushes, would develop along the shoreline and in other areas where the soil is saturated during most of the growing season. Birch, alder, willow, and cattail would probably survive and proliferate in areas where the depth to groundwater is between 1 and 4 ft. Invasion of the grassy portions of the meadows by shrubs is occurring at present, and would continue with the project. These changes would greatly limit the capacity of the meadows to be managed for forage production. The current management plan for the meadows calls for seeding of alfalfa, a forage species preferred by bighorn sheep along the Kootenai River. However, alfalfa grows best in deep, well-drained soils, and cannot tolerate more than one week exposure to water at or above the soil surface (Elliott 1982). The project would render most of the meadow area unsuitable for alfalfa.

LOSS OF RIPARIAN TREE AND SHRUB HABITATS

Even with the best possible restoration and reclamation, the proposed facility would cause a net loss of mature riparian trees and associated habitats. These habitats are unusually diverse and productive but they are becoming more scarce both nationwide and in the Kootenai valley. Approximately half of the Kootenai River in Montana is impounded by Libby Dam, and another 10 miles would be impounded by the proposed reregulating project, if built. The little riparian habitat remaining along this river thus assumes key importance. Table 4-4 lists the habitat that would be lost as a result of this project.

TABLE 4-4. LAND COVER INUNDATION OR DISTURBANCE FROM THE PROPOSED PROJECT (ACRES)

Land Cover	Inundated at reservoir elevation 2000 ft & flow 25,000 cfs	Acres disturbed by railroad relocation	Total	Inundated at reservoir elevation of 1990 ft & flow of 50,000 cfs**
Douglas fir-Western red cedar	2.31	5.49	7.80	0.00
Douglas fir/ninebark	1.74	0.62	2.36	0.69
Ponderosa pine-Douglas fir	1.06	0.00	1.06	0.47
Douglas fir/shrub	0.00	2.00	2.00	0.00
Cottonwood-conifer	5.69	1.89	7.58	1.94
Riparian cottonwoods	5.02	0	5.02	4.37
Gravel bar (Including exposed rock)	4.37	0.01	4.38	4.06
Cattail marsh	0.01	0	0.01	0.01
Grassland and hayfields	3.43	0	3.43	3.13
Powerline right-of-way	0.43	0.63	1.06	0.01
Railroad right-of-way	6.21	8.74	14.95	1.13
Birch-alder-dogwood	0.43	0	0.43	0.36
Willow	0.88	0	0.88	0.21
TOTAL	31.58	19.38*	50.96*	16.38

** Includes 8.74 acres of existing railroad right-of-way which would become part of the new railroad right-of-way.*
*** There is no information on inundation at a flow of 25,000 cfs at 1,990 ft, but the inundation at 50,000 cfs would be only slightly greater.*

HARLEQUIN DUCK LOSSES

An uncommon species occurring in the falls area is the harlequin duck, which breeds in the turbulent water of the falls. A brood of three was observed in the summer of 1980 (Rogers 1980) within 200 yds upstream of the falls in an area containing the only cattails on the project area and providing the calm backwaters known to be preferred by harlequins for brood rearing (Kuchel 1976). The number of adults recorded at the falls ranged from a low of three in 1979 to a high of eight in 1981 (Nichols 1982). Harlequins were seen in many places in and near the falls, but appeared to prefer the swift water at the crest for feeding and the rocky promontory just upstream of the falls for loafing habitat. A pair was seen in the river among boulders at China Rapids (DNRC 1981a).

The destruction of feeding, breeding, brood-rearing and loafing habitat and the effects of 4 years of construction-related disturbance would almost certainly eliminate the harlequin duck population from the project area (Nichols 1982). The harlequin duck is rare in Montana, and the falls is the only readily accessible viewing area outside Glacier Park. It also is one of the few known breeding areas in Montana. The importance of the viewing opportunity provided by the falls is likely to increase with time.

BIGHORN SHEEP LOSSES

A notable wildlife feature in the project vicinity is the Kootenai Falls bighorn sheep herd on the north shore of the river at Kootenai Falls. The herd was introduced in 1954 and appears to be well established. The area used by sheep near Kootenai Falls includes land that the Army Corps of Engineers purchased to partially replace bighorn sheep range inundated by Libby Dam. Figure 4-6 shows the range of the Kootenai Falls herd and other wildlife uses. DNRC researchers studied the sheep from 1977 to 1982 and noted that sheep use the lowest elevations in their range in March and April and move higher as summer progresses.

In 1981, DNRC did a study to determine the extent to which sheep used the replacement habitat purchased by the Corps of Engineers (Nichols 1982). Forty-seven sheep were counted within 0.5 mi of the Sheppard Meadows on May 27, which was the largest single count of sheep made in this area during the study. Most of these sheep were located near broken, rocky "escape" cover of the type known to be used by sheep during and after lambing in other areas (Geist 1971, Stelfox 1976, Shannon et al. 1975). All sheep in the herd probably use the Corps replacement habitat at some time (Brown 1982). Sheep on the habitat were often seen using a salt block and browsing on shrubs near the eastern boundary of the upstream meadow, and bedding and browsing on the rocky timber slopes. Few sheep were seen in the Sheppard Meadow grasslands.

Bighorn sheep would probably be displaced from parts of their present range by construction activity. This could result in increased stress and decreased birth rates. Increased mortality from illegal shooting could result because of increased numbers of people in the area. The inundation and vegetation changes caused by elevated groundwater levels in the Sheppard Meadows would make it difficult to manage the area for sheep use in the future. A reduction in the population of sheep would result in a decrease of hunting permits issued for the area. Bighorn sheep are one of the most highly prized game animals in Montana, and already the number of applicants for sheep permits is about 300 times the number issued. A reduction in the number of permits issued would adversely affect hunting opportunities, and a change in abundance or distribution would probably reduce viewing opportunities.

REDUCTION OF IMPACTS

Table 4-2 lists some possible measures for reducing or eliminating potential impacts of the project. A summary of these measures is presented below. To be most effective, details of impact reduction strategy could be worked out in consultation among appropriate state and federal agencies.

1) One of the most effective measures for reducing losses to riparian habitats and to the replacement habitat (including the Sheppard Meadows) would be to design the proposed project with a reservoir elevation lower than the proposed 2,000 ft. For example, if the reservoir surface were to be at 1,990 ft rather than 2,000, the amount of deciduous tree and shrub habitat inundated would be reduced from about 12 acres to about 7 acres (table 4-4). Groundwater effects in the Sheppard Meadows would be much less, and only the downstream meadow would sustain impacts.

2) Effects of elevated groundwater on existing vegetation in the Sheppard Meadows could be

reduced by installing drainfields or raising the ground surface with fill. Drainfields would be very costly and would require disturbance of vegetative cover and of archaeological sites. Unless combined with a pumping system, their effectiveness would be small. Rock excavated from the tunnel system could be transported to the meadows, perhaps via a conveyor across the river, and covered with topsoil to provide an unsaturated area equivalent to the present meadow area. The costs of this measure would probably be quite high.

3) The applicant proposes to restore contours and vegetation on the south bank upstream from the falls using fill from the tunnel excavation with a cover of material suitable to allow establishment of coniferous and deciduous vegetation. This revegetation would be acceptable only if it quickly restored a structurally diverse community of grass, shrubs, and tall trees. Natural reestablishment might take 100 years or more, so it would be necessary to plant grass, shrub seedlings, and tree saplings to provide suitable growth more quickly. The reservoir shoreline could be contoured to provide coves for waterfowl brood rearing and feeding. A plan for the restoration of riparian habitat, developed in consultation with appropriate state and federal agencies, could be reviewed and approved by the Board before the beginning of construction.

4) If some of the trees killed by inundation were to be retained along the reservoir edge rather than removed as proposed by the applicant, they would continue to be used as perch trees by bald eagles, osprey, and other species. Cavity-nesting species such as tree swallows would probably use these dead trees when cavities developed.

5) The probability of conflicts between wildlife and human use of the area would be reduced if recreational development of the area near the falls were limited to improvement of existing facilities.

6) Instructing construction and operation personnel on avoidance of conflict with wildlife could be effective in reducing disturbance of big game, raptors, and other species.

7) Disturbance to wildlife could be reduced if workers were bussed to the site from designated parking areas outside the project area, as proposed by the applicant. Private construction vehicles could be banned from the area except as needed for emergencies.

8) The possibility of illegal shooting of wildlife would be reduced if possession of firearms by construction workers were prohibited in the construction area.

9) If the applicant were required to fund an additional game warden during the construction period, the probability of illegal shooting or harassment of wildlife would be reduced.

10) Chances of adequate reduction of groundwater effects in the Sheppard Meadows and restoration of habitat on the south bank would be improved if the applicant were to post a bond that would be released when the impacts had been adequately reduced.

COMPENSATING FOR UNAVOIDABLE IMPACTS

Even if the impact reduction measures proposed above were entirely successful, there would still be a net wildlife loss. These losses are summarized in the right column of table 4-2. The following measures are possible means of compensating for these losses.

1) The loss of the replacement habitat by inundation could be compensated for if the applicant were required to replace all the affected parts on an acre-for-acre basis. This compensation would be effective only if the land acquired could be managed to support a population of affected species equivalent to the project-related losses, and if it could be given long-term protection against degradation. The location of the replacement land could be approved by the Board and purchased before the beginning of construction.

2) Even if the applicant were to reclaim as much vegetation as possible along the south bank, there would still be some net loss of habitat. Some of this loss would be permanent and some temporary, lasting until the eventual restoration of the forest canopy on the south bank. A number of options are available to ensure that losses are compensated for and that there is not a net loss as resulted from Libby Dam. The applicant could rehabilitate degraded riparian habitat elsewhere to provide acre-for-acre replacement for all tree/shrub habitat lost along the river. Land suitable for this purpose could be identified by DNRC in consultation with NLI and representatives from DFWP, USFS, and USFWS, approved by the Board and purchased before construction begins. See Nichols (1982) for additional discussion of this option.

3) To compensate for lost wildlife viewing opportunities (especially bighorn sheep) and the loss of ability to manage the meadows for bighorn sheep, NLI could enhance the opportunity for public viewing of the Kootenai Falls bighorn sheep herd by funding appropriate habitat management to increase the herd. If a study is necessary it could be designed to determine ways to benefit the herd. To be most effective, study could begin before the start of construction.

RECREATION AND AESTHETICS

This section describes the existing recreational and aesthetic environment at Kootenai Falls, how people use the area for recreation, and how recreation would change if the dam were built. The potential for reducing adverse impacts is then discussed. Following this is an estimate of the economic value of recreation at the falls, both with and without the dam.

When specific recreation management plans and objectives are absent, as is the case at Kootenai Falls, user preferences are valuable guidelines for decision-making (Clark and Stankey 1979). The data DNRC used in its recreation analyses came from three primary sources: an onsite survey of visitors at Kootenai Falls; a mail survey of Lincoln County residents; and a field inventory of the river from Libby Dam to the Moyie River in Idaho. A complete discussion of the methods and findings is in DNRC's Kootenai Falls recreation working paper (Allen, S. 1981).

EXISTING ENVIRONMENT

The biological, physical, social, and managerial conditions present at Kootenai Falls combine to give the setting its scenic beauty and recreational value. The following discussion is based on a framework for describing recreational environments developed by Clark and Stankey (1979).

THE SETTING

The main recreational feature of the area is the falls itself, which provides a powerful display of the forces of nature. Lincoln County residents indicated that viewing the falls at high flow levels added greatly to their recreational enjoyment. Unlike waterfalls consisting of a single long drop, Kootenai Falls has one main drop and a series of lesser drops, rapids, islands, pools, and waves that change completely as flows vary. Access to Kootenai Falls is excellent; Highway 2 runs along the entire area that would be affected by the project. The falls overlook area provides a view of the falls (photograph 4-3). Several turnoffs and dirt roads along the river upstream from the falls allow easy access for boaters and fishermen. A pulloff one-quarter mile west of the overlook provides parking for footbridge visitors. Between this pulloff and the overlook is a small picnic area and interpretive sign.

Access within the falls area is by walking on trails with rocky and steep spots. Rocky terraces border the river at the falls and downstream canyon. Foot access to the north shore is provided via the swinging footbridge suspended over the canyon downstream from the falls (photograph 4-4). Walking across the bridge is an exciting experience, as it sways with the weight of visitors who must hold on to cables suspended at shoulder height. The bridge crosses a chasm with major rapids upstream and downstream, affording spectacular views. Paths along the north shore stretch from the bridge to upstream of the falls, providing views of the cascading water.

Another recreational feature near the project area is old Highway 2, the National Parks Highway, so-called because it was used by early day motorists traveling to and from Banff and Jasper National Parks in Canada and Glacier National Park in Montana. Now overgrown with vegetation, this road is an attractive hiking trail.

Man-made modification of the falls setting is apparent in only a few areas. The footbridge, picnic grounds, and falls overlook are the only recreational developments, aside from several signs warning visitors of sudden water level fluctuations. The existing modifications blend well with the natural setting. Facilities are the bare minimum needed to perform the desired function: weathered picnic tables, rough trails, poorly-maintained pit toilets, and a simple interpretive sign. The current level of recreation management by the Libby Lions Club is very low, with few regulations or restrictions on visitors. Most of the visitors surveyed onsite (74 percent) did not want recreation facilities added or improved. The applicant's onsite survey reached a similar conclusion; the largest single category of respondents wanted the falls left"as is."

Although other types of development are present at or near the falls, the area retains a natural character. Railroad and auto traffic noise sometimes intrude on the natural character of the site, but vegetative screening and the roar of the falls at average flows eliminates these distractions.

The most common reason onsite visitors gave for visiting the falls was to enjoy natural scenery, ranked as the most important of five reasons by 75 percent of those interviewed by DNRC. The setting's natural character also contributed to Lincoln County residents' enjoyment of the Kootenai Falls area; 80 percent of those surveyed by mail said the area's natural features added to their recreational enjoyment of Kootenai Falls.

PHOTOGRAPH 4-3 THE FALLS OVERLOOK

The visual management plan for the Kootenai National Forest requires its lands at and near the falls (Management Unit #5) to be managed for Retention, "a visual quality objective which in general means man's activities are not evident to the casual visitor" (USDA 1974). This classification is used for distinctive landscapes where viewers have high expectations for scenic quality.

Recreation visitors considered Kootenai Falls to be comparable to the nation's finest natural scenic attractions. One question on the onsite survey was, "is there a place near your home that is comparable to Kootenai Falls?"

Thirty-nine percent said there was no comparable place near their homes. More surprising, however, were the places considered comparable by the other 61 percent. Although many locals listed regionally-known water settings such as Yaak Falls, out-of-state visitors compared Kootenai Falls to nationally-recognized scenic attractions in their respective regions.

Individuals from California listed Yosemite National Park, Big Sur and the California coast, Redwoods National Park, and Lake Tahoe as comparable. Canadian tourists compared Kootenai Falls to Banff National Park and Hell's Canyon on the Fraser River. Oregon and Washington residents compared the falls to the Pacific coast, the Cascades, the Columbia River gorge, Puget Sound, Mt. Rainier National Park, the Rogue River canyon, and Crater Lake. Midwestern residents compared the area to the Badlands, the Mississippi River, the Boundary Waters Canoe Area, and the Black Hills. Visitors from the East Coast believed settings such as the Everglades, Cape Hatteras, and the Atlantic Ocean to be comparable. Southwestern residents compared the falls to the Grand Canyon and Saguaro National Monument. Montana residents thought the falls comparable to Glacier National Park, the Bob Marshall Wilderness, Flathead Lake, Yellowstone National Park, and the Cabinet Mountains Wilderness.

ALTERNATE USES OF THE SITE

The main alternate to construction of the project would be continued recreational use of Kootenai Falls and the affected stretch of river. The continuance of such use could be ensured by federal designation as a recreational river in the Wild and Scenic River system (Repac 1979). There is already support for such protection (Rhodes 1980). The area also meets the criteria for designation as a part of the State Recreational Waterway System (ARM 12.8.40).

RECREATIONAL USE

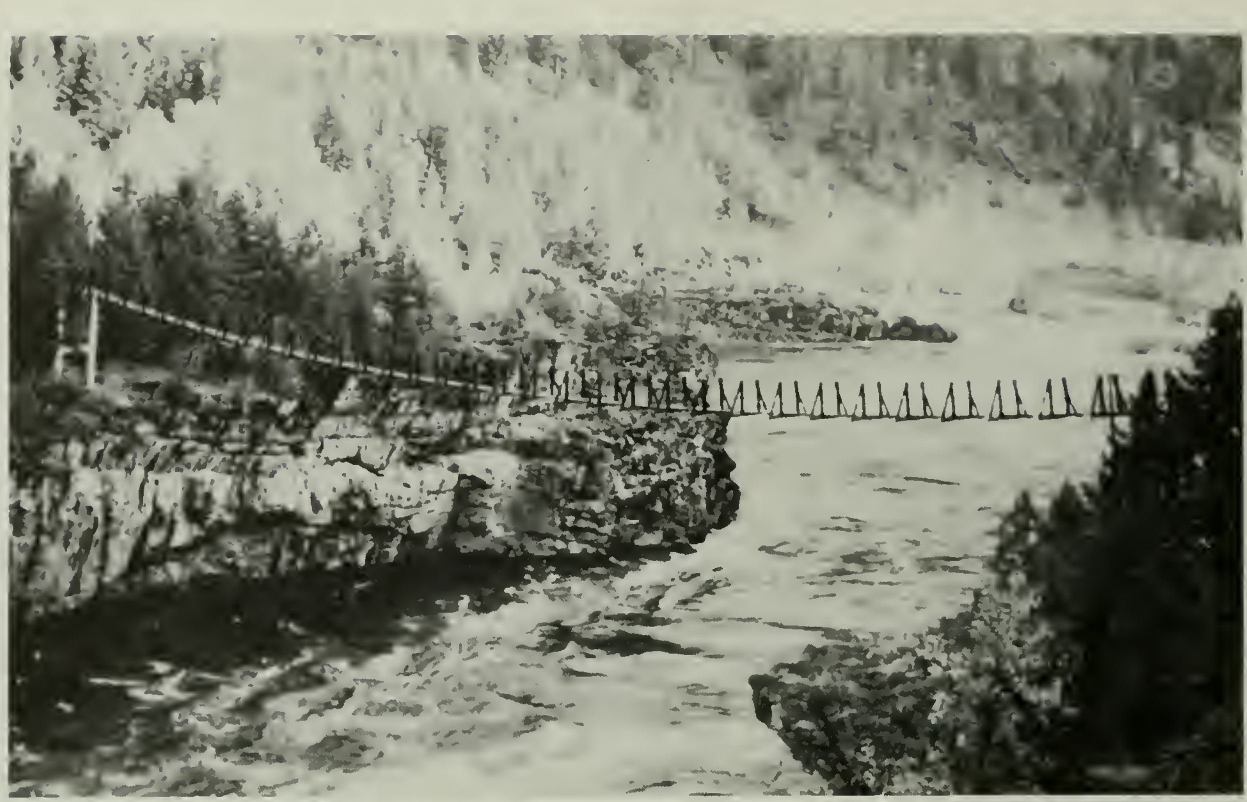
The Kootenai Falls area provides diverse opportunities for recreation, and is visited by people from across the United States and Canada.

Except for fishermen, who are discussed later, the majority of recreation visitors, 78 percent, come from outside Lincoln County. This ratio of local to nonlocal use matches that found by the applicant in its onsite survey. Lincoln County residents stay at the falls an average of 1 hour and 40 minutes (photograph 4-5), compared to about 45 minutes for nonlocal visitors. The falls is a primary destination for about 20 percent of the visitors; 80 percent are stopping at Kootenai Falls enroute to other destinations.

Over 50 percent of the visitors on multiple destination vacations rated Kootenai Falls as one of the best scenic attractions viewed on their trip. Visitors on multiple-destination vacations who were interviewed right at the falls or footbridge were more likely than people who only visited the overlook to rate Kootenai Falls more favorably compared to other scenic attractions viewed on their trip.

The most popular recreation activity is viewing the falls (Northern Lights 1978; Wall 1978; Allen, S. 1981). From the overlook, the falls are framed by trees and set against a steep, rocky backdrop. Recreation visitors who walk down to the falls are overwhelmed with the tumult of rushing water, spray leaping into the air, and the crashing and roaring of the water when flows are average or higher. Although most visit the falls in the summer (Northern Lights 1978), winter visitors come to view and photograph the ice formations.

Fishing is excellent along the entire 5.3 miles of river flowing through the project area. The riffles and pools along the river in the falls vicinity provide well-known angling opportunities, and the river above the falls is rated as a Class I (Blue Ribbon) fishery (DFWP 1980). The average size and catch rates of rainbow trout on the Kootenai from the reregulating dam site to the falls qualify this stretch as one of the best wild trout fisheries in the state (May and Huston 1979). Fishing pressure has increased markedly in recent years; 1978 use levels on the segment of river that would be impounded were estimated at 1,630 man-days per mile, a high rate even in comparison to Montana's other popular trout streams (Graham 1979c). (See section on Aquatic Life and Habitat for a complete discussion of fisheries.)



PHOTOGRAPH 4·4 THE SWINGING FOOTBRIDGE

PHOTOGRAPH 4·5 VISITORS RELAXING BY THE FALLS

Recreational use patterns of fishermen were expected to differ from those of other recreation visitors, so DNRC developed a special questionnaire for them. All 114 anglers interviewed by DNRC were eager to talk about fishing, and they had been fishing for an average of 25 years. Unlike most visitors to other parts of the falls vicinity, 54 percent were from Lincoln County, 15 percent from elsewhere in Montana, and 31 percent from other states. Their average stay was four hours, and 71 percent were repeat visitors.

They had been fishing that stretch an average of 15 times a year for 11 years. Thirty-five percent used flies, 30 percent bait, 20 percent lures, and 15 percent a combination. The majority of anglers, 57 percent, rated size of fish caught as more important than quantity. According to Bryan (1977), anglers with these characteristics depend heavily on specific fishing resources, and would be sensitive to any changes in the setting.

The area's visual qualities were important to the anglers, even more important than catching fish. Two-thirds of the fishermen rated enjoyment of scenery as their main reason for fishing, supporting the contention that fishing success is only one component of the angling experience (Bryan 1977; Knopf et al. 1973; Shew and Werner 1976).

Seventy-eight percent of the fishermen said that the stretch of the Kootenai on which they were interviewed was one of their favorite fishing spots. Over 95 percent thought that portions of the potentially altered stretch of river were unique in Lincoln County. Eighty-nine percent thought the stretch unique in Montana, and 79 percent rated it as unique in the country.

Other activities — picnicking, hiking, wildlife viewing, camping, boating, and just relaxing — are also related to nature appreciation. Camping opportunities are plentiful, with no fees, regulations or limitations on camping sites. The north bank and hillside area is home for a herd of bighorn sheep, photographed by many and hunted by those who are able to obtain permits. Harlequin ducks, rare in Montana, can sometimes be seen playing in the falls and rapids.

The rapids upstream and downstream from the falls provide opportunities for exciting whitewater boating, although present use levels of this resource are low. Whitewater in the downstream canyon, the only such constricted reach on the Kootenai in Montana, is very challenging for boaters (class III - V on a scale of I to VI), with sharply angled waves, large holes, and powerful hydraulics. Upstream, China Rapids is the most notable whitewater, the largest rapids on the river other than those in the downstream canyon. The Western News (1981) reported that,"These rapids offer a brief but wild ride to expert rafters and canoeists." There are also reports of kayakers running the falls, but these remain unconfirmed.

Kootenai Falls is a valuable recreational resource for Lincoln County residents. In the past two years, 90 percent of the DNRC mail survey respondents from Troy, 87 percent from Libby, and 50 percent from Eureka visited the falls at least once. Over 40 percent of those from Libby or Troy visited the falls six times or more in the same period, and 15 percent visited 20 times or more.

When asked to name their three favorite places for water-based recreation in or near Lincoln County, far more residents chose the Kootenai Falls area than any other site. Eighty percent of the sample said the recreational value of Kootenai Falls was important or very important to themselves and their families. Over two-thirds believed there were few or no comparable places in Lincoln County, and over half said the falls were unique in the entire state. The falls also was valued by those who visit it infrequently or not at all; 77 percent of the county residents said they were glad natural waterfalls such as Kootenai Falls exist, even if they seldom visit them.

Use Levels

Based on its survey, DNRC estimated current annual recreational use level of the project area to be 64,000 visits, compared to the applicant's estimate (for 1978) of 50,000. This difference could indicate rising use levels, but could also reflect the sampling error inherent in both surveys.

IMPACTS

CONSTRUCTION IMPACTS

For 4.5 years, Kootenai Falls would be dominated by construction activities, replacing the scenic natural environment as the area's central focus.

Visitors to the falls during construction would be confronted with the noise and dust from construction activity that would damage existing visual qualities in many ways, and from many viewpoints (FERC 1981). Activities and experiences depending on scenic beauty and the natural setting would be diminished in quality, and public access to the falls, access road, and outlet portal areas would be restricted. Fishermen would probably continue to visit the upper reaches of China Rapids during construction, but fishing at and below the falls would be greatly reduced, if possible at all.

People trying to visit the falls could encounter substantial traffic delays because of haul truck traffic on Highway 2. Travel to and from recreation settings is an integral part of the recreation experience (Clawson and Knetsch 1966), and falls visitors regard travel to and from the site as an enjoyable part of their experience (Duffield 1981). Travel disruption could be an important impact. All of these construction-related impacts would be unavoidable.

A new type of recreation opportunity would be created — viewing a large-scale complex construction project. Lincoln County residents expressed some interest in visiting the site during construction. Those who currently visit the falls frequently, however, planned to visit far less often during construction.

OPERATION IMPACTS

The proposed project would greatly reduce flows over the falls, a major impact on the setting's aesthetic qualities (Suttle 1982). Ninety-five percent of the time, 750 cfs would flow over the falls, a discharge less than the lowest flow ever recorded. Cleary (1980) said that the reduced flow would create"an empty set of rock ledges emanating from a large concrete structure covered only with a thin flow of water."

Reducing the flow to 750 cfs would greatly decrease existing flow variability, distribution, and diversity of water surface textures in the partially dewatered reach. The impressive sounds generated by higher flows and the accompanying spray and mist would be eliminated (Dalby 1981b). River channel depth would be reduced by half in parts of the downstream canyon. Above the footbridge, water velocity would be reduced 30-40 percent and river width reduced 50-60 percent below what it is at 4,000 cfs (Dalby 1981b). Much of the whitewater now present at average flow levels would be eliminated.

The dam structure would be covered by a steady stream of 750 cfs flowing over the top, but would still be visually evident to the point of dominating the landscape. The 30-ft tall, 925-ft-long concrete and steel structure would stand out in the narrow river valley, especially because it would be placed immediately above Kootenai Falls, a popular natural scenic attraction. The concrete dam abutments, intake platform structure, log boom, signs, roads, and fencing would accentuate the dam's adverse visual impacts.

Project features would change the landscape image from scenic to developed and utilitarian (Cleary 1980). For at least as long as the project was in operation, it would violate the Kootenai National Forest's visual quality objective of"Retention" for its land surrounding the falls (Schelvan 1981).

The applicant's proposed recreation development plan, although making access to the falls easier, would alter the aesthetic resource. Upgrading recreation facilities does not necessarily improve recreation quality, and can have an adverse effect if not properly planned to enhance the recreation resource (Clark and Stankey 1979). Access both to and within the falls area would be changed by the addition of an access road, more parking areas, and improved trails to the falls from the overlook. Site modification would be more prevalent and would cover a broader area. FERC recommended removing the bridge to protect archaeological resources and make the river area safer for recreation visitors. The proposed recreational development was shown in DNRC surveys to be inconsistent `with user preferences, and would add to the harmful impacts on the natural quality of Kootenai Falls. Relocation of the railroad tracks could place trains more in the view of falls overlook visitors.

Damage would also occur to the fishery above and below the falls (see section on Aquatic Life and Habitat for complete discussion). Of the remaining stretches of whitewater on the Kootenai in Montana, the best are in the downstream canyon and at China Rapids. Much of the former would be severely dewatered, and the latter would be flooded out by the reservoir.

IMPACTS ON RECREATIONAL USE

The changes in the recreational and aesthetic environment outlined above would have substantial effects on recreational use patterns.

Although it would technically be possible to view the falls if the dam were built, visitors would be viewing a developed, dewatered falls, with a resulting decline in the quality of the experience.

Fishing would be affected in two ways. Anglers would be adversely affected not only by the reduction in the quality of the trout fishery, but by the decline in the area's scenic beauty and naturalness.

Other nature-related activities such as photography, hiking, picnicking, and camping, would also be available after dam construction, but the quality of the experience would be diminished by the changes in aesthetics. Whitewater boating opportunities would be adversely affected. The opportunity to view harlequin ducks would be eliminated when the ducks leave the project area.

Seventy-eight percent of the visitors interviewed onsite opposed the project, 14 percent were neutral and 6 percent favored it. This matches the findings of another survey (Wall 1978), which found that 76 percent of a sample of Kootenai River recreation visitors opposed the project.

The visitors had strong opinions on the projects' impacts on recreation: 61 percent thought the effects would be adverse; 18 percent thought that few changes would occur; and 14 percent thought the impacts would be favorable.

Visitors' expectations of adverse impacts and negative attitudes toward the project were reflected in their intentions to visit the area much less frequently if the project were built. Sixty-four percent said they would visit the falls less often; 34 percent said they would visit about as often, and only two percent said they would visit more often.

Eighty-four percent of the fishermen asked about their attitudes toward the proposed project were opposed. Six percent were neutral, and 11 percent in favor of the dam. (The figures do not add to 100 percent because of the rounding off of the percentages).

Fifty-three percent of anglers said the project would ruin fishing opportunities, and an additional 18 percent thought the fishing quality would be harmed somewhat. Their expectation of adverse impacts was reflected by their intentions to visit the area far less frequently if the project were constructed. A large reduction in fishing use by current anglers could result from the project (68 percent said they would not fish there at all after the dam was built).

The mail survey asked Lincoln County residents if they believed the project would affect recreation and aesthetics. When asked about the level of impacts expected, the largest percentage of residents predicted substantial impacts on both recreation (37 percent) and scenic beauty (45 percent). Only 16 percent said there would be no impacts on recreation in the falls area, and 10 percent foresaw no impacts on scenic beauty. When asked about the type of impacts expected, two-thirds of the sample said they expected the project to have adverse or highly adverse effects on scenic beauty, and over one-half predicted harm to recreation opportunities.

These responses were more pronounced among frequent visitors to the falls area. Of those who visited the falls 20 or more times in the past two years, over 70 percent predicted that the dam would have substantial adverse effects on recreation. In contrast, less than 20 percent of the infrequent visitors expected substantial adverse effects on recreation. Eighty-four percent of the frequent visitors predicted that the project would have substantial impacts on scenic beauty, and over 90 percent expected those impacts to be adverse. Of those who had not visited the falls at all in the previous two years, however, only 41 percent expected impacts to be adverse.

Thirty-one percent of the residents expected to visit the falls less frequently if the dam were built, 33 percent the same, and 20 percent more. Frequent visitors expected to visit the falls much less often if the project were constructed, and residents who currently don't visit the falls expected their use levels to remain the same or increase.

The setting changes would produce new opportunities — touring the power station, viewing the dam, and activities centered on a flat-water resource. New demand for such opportunities might be created. To interpret this demand and its relationship to future use levels, it is necessary to look at the rest of the Kootenai River in Montana. Half of the river has been dammed, creating abundant flatwater, reservoir-oriented recreation opportunities. At Libby Dam, visitors can tour the power station and the visitor center maintained by the Army Corps of Engineers. Marinas, boat-launching, and camping facilities provide access to Lake Koocanusa. No such facilities are planned for the reservoir that would be created by the proposed project.

Below Libby Dam, the river remains predominantly smooth and calm to the Idaho border. Much of the river below Libby Dam is available for flat or slow-moving water-based recreation, with a range of access levels. The one exception is found in the project area, where the rapids, falls, and canyon disrupt an otherwise placid river.

The type of recreation opportunities that would be created by the project are already found nearby. The existing opportunities for recreation at the falls that would be lost or diminished in quality are unique, not available on the rest of the Kootenai. Creating another reservoir and altering the falls' aesthetic qualities would therefore not be expected to attract many new visitors. Visitors interested in the falls and aesthetics would probably not stay as long. Fewer people would walk down to the falls, which would be dewatered and visually dominated by the dam at its crest. Fewer people would consider the falls as a primary destination for recreation, despite the upgraded access and facilities.

ALTERNATE USES OF THE SITE

The two most evident uses of the falls are for recreational purposes as at present, or development as a power source. Development as proposed would substantially alter the recreational and aesthetic qualities of the falls, and would preclude its classification under the Wild and Scenic Rivers Act. The act, as amended through Public Law 93-621, defined Recreational River areas as follows:

> *Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.*

It is clear that the segment of the Kootenai affected by the project would probably not be eligible for inclusion in the Wild and Scenic River system until abandonment of the project, at least 40 years after the start of operation. If other forms of development were to occur along the river during this period, preservation in its present condition would be precluded. The proposed project would mean for all practical purposes that this unique segment of the Kootenai could not be preserved; the project and Wild and Scenic River designation are incompatible.

REDUCTION OF IMPACTS

In general, there is little potential for reducing the adverse impacts on recreation and aesthetics. Several measures could be taken to reduce impacts slightly, but most would remain unaffected.

Northern Lights proposed to reduce the impacts of dewatering the falls by redistributing the 750 cfs that would flow over the dam, to make the falls appear as though the flow actually were much higher. The plan is to redistribute the 750 cfs with irregularly placed, rock-like concrete structures below the dam, forcing water over the south drops that at present are not covered at flows under about 8,000 cfs.

The usefulness of this measure is unknown. It is not known whether the concrete structures would be visually obtrusive, and this would not be known until they were actually in place.

Even if the redistribution plan were effective, however, simply wetting the same rocks that are now wet at flows of 8,000 cfs would not replicate the natural waterfall at high flows. The crashing and roaring sounds, spray and mist leaping into the air, and diversity of flows would be lost.

Also, there would be a concrete dam at the crest of the falls, which the applicant says would constitute a major unavoidable visual intrusion. The combination of the greatly lowered flows and the dam structure itself, along with the related project features such as the abutments, intake structure, and fencing, would together constitute a major adverse impact on the aesthetic resource.

The aesthetic impact of the dam structure and the reduced flows could be decreased if the dam were built to maintain a reservoir elevation of 1,990 ft, rather than 2,000 ft as proposed, and by letting flows greater than 750 cfs over the dam and falls. The lower reservoir would be slightly less visually intrusive than the proposed reservoir. This effect could be enhanced by allowing flows of about 4,000 cfs over the dam during the summer when the bulk of recreational use occurs. In 1970 the Army Corps of Engineers said minimum releases of about 4,000 cfs from its proposed reregulating dam would maintain the aesthetic qualities of Kootenai Falls.

Visitors to the falls do not want changes in the development level of recreational facilities at the falls. This was found in surveys conducted by both the applicant and DNRC.

Therefore, the applicant could consider dropping the interpretive program and the falls overlook from its plan for development. Trails could be upgraded, but not as extensively as planned — only the minimum needed to prevent excessive erosion and accommodate safe foot travel. Restroom facilities could be replaced, but could be rustic in quality, and not obtrusive. Parking could be upgraded, but without signs, markers, or barriers. The railway underpass would make the hike to the falls and dam safer. If structurally feasible, the underpass could be constructed from native rock or wood, rather than concrete as planned.

These changes in the recreation plan would help to avoid unnecessary modifications of the natural environment, and would be more in line with visitor preferences.

ECONOMIC VALUE OF RECREATION AT KOOTENAI FALLS

During the past two decades, economists have conducted much research on estimating the value of recreation, and such value now can be compared to the value of resource development (Duffield 1981). Some economists have claimed that estimates of a site's recreational value can be obtained "in the same terms and with perhaps the equivalent precision as the power values derived from developing a site for electricity generation..." (Krutilla and Fisher 1975.)

There are two types of economic values associated with outdoor recreation resources: direct use values and indirect use values. Direct use values are associated with onsite recreation, such as the value an angler derives from fishing on a favorite river. Indirect use values are associated not with actual use of the resource, but with the knowledge that it is there. There are three types of indirect values (Krutilla 1967). Bequest value is the satisfaction derived from knowing that future generations will be able to use the resource in its existing state. Option value is the value an individual places on maintaining a recreation resource so that it can be visited in the future. Existence value is derived from just knowing a resource exists, regardless of an individual's current or potential use of it.

EXISTING ENVIRONMENT

DNRC's onsite survey provided information for estimating the direct and indirect value of recreation to current users of Kootenai Falls. Recreational demand at the falls was estimated by two methods: the travel cost method; and the contingent valuation method, which was applied in three different ways (U.S. Water Resources Council 1979).

The travel cost method entailed asking visitors about their travel expenses and amount of time spent reaching the falls. Information for this analysis came from the responses to two questionnaires. One of them was completed by 281 visitors to the falls, and the second, a shorter version of the first, was completed by 181 visitors.

The travel cost method assumes that per capita use of a recreation site will decrease as the cost of traveling to the site increases. A demand curve is derived using out-of-pocket and travel time costs as a proxy for price. For the Kootenai Falls analysis, this demand curve was constructed separately for visitors whose primary destination was the falls (20 percent of the sample), and those who were stopping at the falls enroute to and from somewhere else (80 percent of the sample). The recreational value was then computed from these demand functions. The travel cost method produced an estimate of $355,600 as the annual value of recreation at Kootenai Falls. This estimate pertains only to direct use value, which is a small percentage of the total value.

The second estimate of the recreational value of Kootenai Falls was gained using a willingness-to-pay method. DNRC obtained responses from 113 visitors to the falls regarding how much they would be willing to pay as an entrance fee to the falls. Using a bidding technique, DNRC determined that the maximum amount people were willing to pay was an average of $2.36, resulting in a total estimate of value of $85,200 a year. Like the travel cost estimate, this figure accounts only for direct use. The willingness-to-pay entrance fee estimate is lower than the travel cost estimate probably because it was influenced by what people are accustomed to paying as entrance fees to natural attractions (such as National Parks).

A third estimate of the falls' recreational value was obtained using another variation of the willingness-to-pay method, in which 103 falls visitors indicated how much they would be willing to have added to their monthly utility bills if it meant the falls would not have to be developed. Using the same bidding technique as used for the entrance fee approach, the average amount people were willing to have added was $3.85 per month, for an estimate of $1,060,700 annual recreational value of Kootenai Falls. This estimate was higher than the previous two because it included indirect value, meaning that people were willing to pay more on their utility bills every month, even though they might not visit the falls frequently. This implies consideration of option, bequest, and existence values, but only for current users.

The final method of estimating the recreational value was a different approach of the contingent valuation method, called the "compensation," or "willingness-to-sell" approach. DNRC obtained responses from 65 visitors on how much the applicant would have to pay them (by reducing monthly utility bills) to make up for disturbing the Kootenai Falls site. The average amount visitors said they would have to be paid on their monthly bills was $22.09, which resulted in an estimate of $7,916,800 as the annual value of recreation at the falls. This estimate also included some indirect values of current users, because the payments would be made each month, although visits to the falls might not be made during all months. This estimate is about eight times higher than the estimate based on willingness-to-pay (on monthly electric bills) in part because the amount people can pay is limited by their incomes, but the amount they could accept in payment is not. This disparity is common; other studies have found that the compensation approach sometimes produces value estimates 3 to 20 times higher than willingness-to-pay value estimates (Duffield 1981). These compensation values are based on only 72 percent of the sample that completed questions on compensation. The other 28 percent of the sample said they simply could not be compensated.

Table 4-5 summarizes the estimates for each of the four methods.

TABLE 4-5. ESTIMATES OF CURRENT ANNUAL VALUE OF RECREATION AT KOOTENAI FALLS*

Method	Value for all visitors	Value for Montana resident visitors only**
Compensation	$7,916,800	$2,302,270
Willingness-to-pay (electric bill)	1,060,700	172,608
Willingness-to-pay (entrance fee)	85,200	30,399
Travel cost	355,600	102,807

** All values based on DNRC's estimate of 64,000 visits annually.*

*** This column is provided because the cost benefit analysis (see chapter six) was based on costs and benefits to Montanans only.*

All visitors who were asked willingness-to-pay (entrance fee and utility bill approaches) and compensation questions were also asked whether they thought the approach was valid. Specifically, visitors were asked how realistic or unrealistic they felt the approach was, and how good or poor a guide for decision making their responses would be. The results showed that people had confidence in all three techniques. The procedures were rated as realistic by 67 percent who completed willingness-to-pay (electric bill) questions, 65 percent of those who completed willingness-to-pay (entrance fee) questions, and 63 percent who completed the compensation questions. Similarly, the responses were rated as a good guide for decision making by 71 percent who completed willingness-to-pay (electric bill) questions, 65 percent who completed willingness-to-pay (entrance fee) questions, and 72 percent of those who were asked compensation questions. No one interviewed rated any of the three approaches as "very unrealistic" or as a very poor guide for decision-making.

As expected, the estimates derived from the four methods varied widely, because each measured a different type of value associated with Kootenai Falls. There is no single value estimation method that is"right" for all purposes. However, some basic distinctions can be made among the four approaches. The first involves differences between direct and indirect value. The travel cost and entrance fee approaches estimate only direct use values for current visitors. Using these approaches would therefore result in an extremely conservative estimate of the value of the falls.

Knetsch (1980) said that a compensation approach may be more helpful to measure damages or losses to amenity resources, while the willingness-to-pay approach would be more appropriate for evaluating recreational gains. A similar conclusion was reached in an earlier study (Dwyer et al. 1976):

> *The use of willingness-to sell (compensation) to measure lost benefits is fully consistent with the use of willingness-to-pay to measure increased benefits and, in fact, is basic to the spirit of benefit cost analysis.*

This suggests that compensation is a better approach for Kootenai Falls, because the on-site survey results indicated that recreational opportunities would be adversely affected by the project. Duffield (1981) also recommended the compensation approach.

DNRC believes the compensation measure explained above is most likely to represent the value of recreation at the proposed dam site. However, the size of the sample used to determine the compensation value, when coupled with the high number of non-dollar-value reponses to the bid questions and the wide range of dollar response values, does not permit DNRC to quote the willingness-to-pay values and the compensation values with the same degree of statistical validity.

The issue is complex, however, because it hinges also on property rights. If the falls is deemed to be a recreational resource that the public has the right to use, then the best estimate of value would be compensation, or how much the applicant should have to pay the public for altering the resource in ways that conflict with established use. If, however, use of the falls for hydroelectric power is deemed to be an unexercised right of the utility, then a willingness-to-pay measure, or how much people are willing to pay the applicant to give up its rights to build the dam, would be more appropriate.

In either of these two approaches, however, the estimated value is less than the total value because it does not include indirect values of current nonusers of Kootenai Falls — the option, bequest, and existence values discussed earlier. This value would have to be added in to estimate total recreational value of the falls. DNRC did not collect the data needed to estimate these indirect values to current nonusers. Studies of this type have been conducted elsewhere, however. The indirect recreational value of the South Platte River Basin in Colorado, for example, was roughly equal to estimates of the direct use value (Greenley et al. 1980; Walsh et al. 1978). This suggests that the total recreational value (direct and indirect) may be twice as high as the direct use value alone. A more recent study, conducted in western Montana not far from Kootenai Falls, concluded that the indirect values of Flathead Lake were 10-20 times as much as the direct values (Sutherland 1982).

However, including the indirect values of the falls to nonusers would still result in an underestimate of the total value, for two reasons. First, the estimates assume that the use levels of the falls will remain constant, and not increase over the years. Although long-term trends in use levels at the falls have not been firmly documented, data indicate that use levels for the Kootenai National Forest are steadily increasing at about 6 to 8 percent annually. More users would mean higher direct use values in the future. Second, the estimates assume that the value of the Kootenai Falls resource will remain stable over time. Undeveloped waterfalls such as Kootenai Falls are growing more scarce (see"Uniqueness" in Cumulative Impacts section). In the future, people will likely place more value on the undeveloped falls than they do now.

IMPACTS

DNRC also asked visitors how much they would value the falls if the dam were built. The respondents were asked both willingness-to-pay (electric bill and entrance fee) and compensation-type questions, using the same bidding technique used to estimate the value of the undeveloped falls. The results showed that visitors would be willing to pay an entrance fee of about $1.00 to visit the falls if it were developed, or would pay 45 cents a month on their electric bills to use the developed dam site. When asked how much they would allow their compensation to be reduced for the provision of recreation at the (developed) falls, the mean amount was $1.65 a month.

As noted before, the respondents also said they would visit the falls less often if the dam were built; responses indicated that use levels (by current visitors) could drop to about one-third of existing levels. Combining this reduction in both value and quantity of use, the annual recreational value of a developed falls site was estimated as $100,100 using the travel cost method, $14,000 using the willingness-to-pay (entrance fee) method $48,000 using the willingness-to-pay (electric bill) method, and $236,800 using the compensation method. Table 4-6 shows these values compared to the current estimates of value, and the net reduction in value that would accompany the project.

Table 4-6 shows that the loss in estimated recreational value would be substantial. The magnitude of the loss is consistent with the strong opposition to the project that was expressed by frequent visitors to the falls, and with their expectations of adverse impacts. The estimated loss of value would probably be much greater if indirect values of nonusers were included. The loss would also be greater if use levels increased or if future visitors placed more value on the undeveloped falls.

New visitors attracted to the developed falls setting could of course place some value on recreation, lessening the difference between the estimates. As noted in the previous section, however, little increase in reservoir-oriented recreational use is expected to occur.

Recreation at Kootenai Falls, currently the primary use of the resource, is valued highly by current visitors, and even by those who don't visit it. If the project were built, these values would drop substantially. Losses in recreational (and other) resource values must be weighted against the benefits of the project to provide the basis for a sound decision.

TABLE 4-6. ESTIMATED REDUCTION IN ANNUAL RECREATIONAL VALUE

(to all visitors)

Method	Current Value	Value with Project	Net Reduction Recreational Value Caused by the Proposed Project	Value for Visitors from Montana only*
Travel Cost	$ 355,600	$ 58,400	$ 297,200	$ 100,100
Willingness-to-pay (entrance fee)	85,200	14,000	71,200	29,600
Willingness-to-pay (electric bill)	1,060,700	48,000	1,012,700	164,200
Compensation	7,916,800	236,800	7,680,000	2,247,000

* This column is provided because the cost-benefit analysis (see chapter 6) was based on costs and benefits to Montana residents only.

ARCHAEOLOGY AND HISTORY

EXISTING ENVIRONMENT

There are 37 historic and prehistoric sites that could sustain direct or indirect impacts as a result of the project. Twenty of these would be destroyed or damaged by construction or inundation, and 17 would be subject to indirect impacts, such as excavation by amateur artifact hunters who could get to the sites more easily after the project is in place. The 37 sites include 20 prehistoric campsites, a ceremonial site, the portage trail, rock cairn trail markers, 5 rock shelters, one of which has pictographs, a pole structure of yet to be determined function or origin, mining pits, ditches and trenches, a log chute, the Burrell homestead buildings, the site of a railroad construction camp and section house, a swinging footbridge, a small dirt road with unusual rock-walled cuts, and the old National Parks Highway. All these sites are shown in table 4-7, which supplements the following discussion.

Because of their geographic proximity and cultural relationships to each other and the falls area through a long period of time, these sites have been determined to be eligible for listing on the National Register of Historic Places as the Kootenai Falls Cultural Resource District (Bush 1982).

The National Register is a listing ofdistricts, sites, buildings, structures, and objects of national, state, and local significance in American history, architecture, archaeology, engineering and culture that is expanded and maintained by the Secretary of the Interior (16 USC 470). Congress, in the National Historic Preservation Act, authorized this list because it found that "...the spirit and direction of the Nation are founded upon and reflected in its historic heritage," which "should be preserved as a living part of our community life and development in order to give a sense of orientation to the American People."

The high concentration of sites near Kootenai Falls indicates that it was a focal point of human activity. It was a barrier to navigation on a major transportation waterway, where travel was slowed to negotiate a difficult portage around the falls. It was an ideal location for intercultural contact between inhabitants of the area and passing travelers.

TABLE 4-7. SUMMARY OF IMPACTS AND RESOURCES IN THE KOOTENAI FALLS CULTURAL RESOURCE DISTRICT

SITE TYPE	NUMBER	PERIOD										OWNERSHIP				NATIONAL REGISTER CRITERIA				IMPACT CATEGORIES				ADVERSE EFFECT CRITERIA				
		Prehistoric	Early	Middle	Late	Historic	Trade	Transportation	Lumbering	Mining	Settlement/Homesteading	Forest Service	Corps of Engineers	Burlington Northern	Private Individuals	A	B	C	D	1	2	3	4	1	2	3	4	5
Camp	24LN45	x										x							x			x	x	x			?	
Ceremonial site	24LN1012	x	x	x	x	x	x					x				x		x	x			x	x	x			?	
Camp	24LN113	x			x							x							x			x	x	x			?	
Cairns	24LN46	x										x							x			x	x	x			?	
Camp	24LN105	x		x								x							x			x	x	x				
Bridge	24LN231					x						x																
Mining/Lumbering	24LN453,454,455					x			x	x		x				x		x	x			x	x	x				
Portage Trail	24LN112	x				x		x				x				x			x	x		x	x	x	x	x		?
Camp	24LN111	x				x	x	x				x							x		x	x	x	x	x	x	?	?
Mining/Lumbering	24LN456,457,463					x			x	x		x				x			x		x	x	x	x				
Camp	24LN41	x		x		x	x	x				x							x		x	x	x	x	x	x	?	?
Camp/Homestead	24LN172	x		x		x					x		x			x		x	x		x	x	x	x	x	x	?	?
Camp	24LN173	x		x									x						x		x	x	x	x	x	x	?	?
Rock Shelter	24LN183	?											x															
Site of Schoolhouse	24LN184					x					x		x														?	
Camp	24LN174	x	?	x	x								x						x		x	x	x	x	x	x	?	?
Camp	24LN175	x											x						x		x	x	x	x	x	x	?	?
Rock Shelter	24LN232	?											x															
Homestead	24LN185					x					x		x			x			x			x	x	x				
Rock Shelter	24LN233	x				x					x		x						x			x	x	x	x	x		
Pictograph Rock Shelter	24LN234	x			x								x			x		x	x			x	x	x	x	x	?	?
Rock Shelter	24LN235	x		x									x						x			x	x	x	x	x		
Camp	24LN176	x		x	x								x						x		x	x	x	x	x	x	?	?
Camp	24LN177	x											x						x		x	x	x	x	x	x	?	?
Camp	24LN178	x											x	Destroyed by Erosion									x				?	
Camp	24LN179	x											x	Destroyed by Erosion									x				?	
Camp	24LN180	x											x						x		x	x	x	x	x	x	?	?
Camp	24LN181	x		x	x										x				x		x	x	x	x				
Homestead	24LN483					x					x				x			x										
Camp	24LN236	x										x							x		x	x	x	x	x	x	?	?
Road	24LN462					x		x				x																
Camp	24LN230	x										x							x		x	x	x	x	x	x	?	?
Pole Structure	24LN461	?				?						x																
Camp RR	24LN171	x				x		x						x		x			x	x	x	x	x	x	x	x		
Mining	24LN168					x				x				x		x			x	x		x	x	x	x	x		
Camp	24LN166	x												x					x	x		x	x	x	x	x		
Camp	24LN167	x												x					x	x		x	x	x		x		
(Undetermined)	24LN182					x									x					x								
National Parks Highway	24LN237					x		x				x		x	x	x		x		x			x	x	x	x		?

NATIONAL REGISTER CRITERIA (36CFR60.6)

The quality of significance in American History, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of national, state, and local importance that possess integrity of location, design, setting, materials, workmanship, feeling and association, and

(a) That are associated with events that have made a significant contribution to the broad patterns of our history;

(b) That are associated with the lives of persons significant to our past;

(c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) That have yielded, or may be likely to yield, information important in prehistory or history.

DNRC IMPACT CATEGORIES

1. Dam and tunnel construction activities, railroad relocation, improved visitor facilities, and connection to power transmission line;
2. Inundation and groundwater;
3. Inadvertent destruction and vandalism;
4. Cumulative destruction of sites by Lake Koocanusa, the proposed reregulating dam, and the proposed Kootenai Falls dam.

ADVERSE EFFECT CRITERIA (36CFR800.3)

1. Destruction or alternation of all or part of a property;
2. Isolation from or alteration of the property's surrounding environment;
3. Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;
4. Neglect of a property resulting in its destruction;
5. Transfer or sale of a property without adequate conditions or restrictions regarding preservation, maintenance, or use.

The prehistoric campsites along the river in the Kootenai Falls district have the potential to yield evidence of the earliest Indian hunters who passed through the region, the later bands of people who settled there, the first white travelers and fur traders to pass through, and the mining, logging, transportation and homestead settlement of later times. This sequence of human events, known as a cultural chronology, is poorly understood for the Kootenai region. Only a few sites have been studied in depth by archaeologists, primarily during salvage operations related to dam construction, and only a limited number remain to yield the necessary evidence (Davis,C. 1982).

Of particular importance in the Kootenai Falls area is a site that contained a spear point from the early hunter era (10,000 BC to 5,000 BC) (Davis, C. 1982), and another that is believed to be at least 6,700 years old (Hudson et al. 1980). Only one other site in the Kootenai vicinity (but outside the project area) is known to contain early hunter artifacts (Collins 1981). The scarcity of opportunities to learn about the earliest humans to use the area increases the value placed on sites representing this period.

Evidence of a variety of middle prehistoric cultures (5,000 BC to AD 500) has been found along the Kootenai River in Montana, but it is uncertain which groups lived there at any particular time, and where they came from (Davis, C. 1982). Nine Kootenai Falls middle period sites, six of which would be affected by the proposed project, have the potential to better define the characteristics of various groups and the time they were present. Lake Koocanusa inundated over 425 sites, many of which dated from the middle period.

Late prehistoric period sites (AD 500 to 1807) were by far the most common in the Kootenai region until the inundation by Lake Koocanusa. Six late period sites have been positively identified near Kootenai Falls and another 13 undated prehistoric sites may also fall into this group (Davis, C. 1982).

In comparison to earlier periods, the historic period (1807-1930) at Kootenai Falls is well understood. Remnants of early day mining, lumbering, homesteading, and transportation facilities are evident and their historical function generally well-known.

Besides their potential for establishing a cultural chronology of the area, the sites have interpretive value to aid visitors in understanding the treacherous portage of water craft around the falls, early logging techniques, prospecting for minerals, homesteading, and the construction techniques of the first automobile road through the area. (For details on the cultural periods, and specific information on each site and its significance, see Lahren and Schweigert 1981; Davis, C. 1982).

IMPACTS

Impacts to archaeological and historical resources at Kootenai Falls and in the Kootenai region would occur as direct and secondary results of the proposed project. Impacts include those resulting from construction, inundation,`and both inadvertent and deliberate destruction by construction workers and the public. These impacts were divided into categories as shown in table 4-7 and discussed below.

CONSTRUCTION IMPACTS

Seven sites would be affected by construction activities. A portion of the portage trail would be destabilized by site preparation for the north abutment of the dam. A prehistoric campsite that also contains the remains of a railroad construction camp and section house would be covered up or removed in the development of the construction staging area. Excavation for the outlet tunnel would damage the remains of some old facilities whose function is not currently known. Research would be required to determine the significance of this site. Relocation of the railroad would affect a historic mining site, and the old National Parks Highway would be damaged by construction and maintenance equipment working on the vertical shaft that would carry power to the transmission line. Construction of the proposed picnic area and trail would affect two prehistoric sites.

IMPACTS FROM INUNDATION AND GROUNDWATER

Fourteen sites would be adversely affected by reservoir inundation or increased groundwater levels and bank erosion. These include a mining complex, the Burrell homestead, the railroad construction camp and prehistoric sites.

Water levels in the reservoir would be higher than present river fluctuations and bank erosion would be increased. Composition of the Sheppard meadows where three of the prehistoric campsites are located is predominantly inorganic silts and very fine sands, though the eastern ⅓ of the middle meadow has sand and gravel with low content of fine material (Dalby 1981a). A review of reservoir inundation studies indicated that archaeological sites in inorganic silts and very fine sands are most susceptible to erosion, while coarser sand and gravel are moderately susceptible (Lenihan et al. 1977). Bank erosion is accelerated when wind throws water on the shore and it runs back down, causing an undertow. This shifts archaeological materials and destroys the layering that helps determine their age and relationship to other materials in the site. Wave action could cause bank slumping (Garrison 1975).

Two sites in the downstream Sheppard meadow would be saturated with groundwater 40 percent of the year or longer, and another in the middle meadow would be saturated when runoff from major rainstorms was added to the elevated water table caused by the reservoir (Dalby 1981a). Eleven other sites along the present shoreline may also be affected by higher groundwater levels, and depending on soil types, may also be subject to erosion.

According to recent National Park Service studies (Lenihan et al. 1977, 1981) inundation and groundwater saturation cause major transformation of the most valuable evidence found in archaeological sites. These transformations include chemical changes caused by leaching and weathering, and the loss of coloring that characterizes fire hearths and other important archaeological features. Saturated soil causes oxidation of some archaeological components, including iron, which is common in early white trade articles and historic period items. Datable materials such as charcoal, bone, and obsidian tools can be chemically changed and lose their capacity to be dated.

INDIRECT IMPACTS

Indirect impacts would result from deliberate vandalism and inadvertent destruction through use by visitors and construction workers. Three sites have already suffered from vandalism or theft.

IMPACTS TO THE KOOTENAI FALLS CULTURAL RESOURCE DISTRICT

Impacts to individual sites would effect the quality and the diversity of the sites in the district as a whole. DNRC applied the "adverse effect" criteria established by the President's Advisory Council on Historic Preservation (ACHP) (36CFR800.3) to assess the effect the project would have on the sites collectively as a district (adverse effect criteria are shown in table 4-7).

Eighteen sites would be destroyed by construction or inundation and groundwater, and two more probably would be damaged. The loss of these sites would affect the entire district, severely diminishing its current interpretive value, and its potential to yield information regarding the history of its inhabitants.

REDUCTION OF IMPACTS

When FERC is considering whether to approve a proposed project, it is required to consult with the ACHP in regard to any impacts the project would cause to historical and archaeological sites eligible for the National Register, and any feasible or prudent alternatives to the project that could avoid, mitigate, or minimize adverse effects (36CFR800.4(2)). FERC has not yet developed impact reduction plans with the ACHP so this EIS includes only the measures proposed by the applicant, or suggested by FERC and DNRC.

The applicant proposed to reduce the impacts through a program of site preservation, data recovery, and public education. This program was to be detailed in a cultural resource management plan. No plan was developed for DNRC to review before preparation of this EIS, but some general measures were suggested: (1) rip-rap the north bank terraces to prevent further erosion; (2) stabilize the talus slope to prevent alteration of the portage trail; (3) recover data from sites directly affected; (4) avoid the rockshelter sites by drawing the project boundary to exclude them, or flagging or fencing them to safeguard them from inadvertent destruction; (5) impose a financial penalty clause in construction contracts as an inducement to prevent damage; (6) provide a two-part education program to familiarize construction personnel with measures to protect cultural resources, and to interpret resources and caution visitors not to disturb them. The applicant estimated the cost at $50,000.

FERC did not recommend specific measures, but suggested that the design of the management plan should provide for study of the possible benefits to cultural resources of: (1) limiting the level of the reservoir to 1,990 ft, (2) providing flows different than the proposed constant 750 cfs over the falls, (3) removing the suspension bridge to limit access to the north bank sites, (4) consulting with the Kutenai Indians to allow identification and avoidance of sacred places, (5) establishing a monitoring program to detect indirect impacts and plan for site protection, and (6) arranging with the Kutenai Indians for curation or disposition of artifacts recovered during project excavation or salvage archaeology.

DNRC reviewed the two proposals to determine their effectiveness and to identify any potential problems or shortcomings. Limiting the reservoir level to 1,990 feet would moderately reduce inundation effects on archaeological sites. Flows above 750 cfs could reduce but not eliminate visual impacts and noise impacts to the district. At 750 cfs, flows in the partially dewatered reach would be low enough for visitors to walk across the river in some places, so sites are not likely to be protected by removal of the bridge. The bridge is Forest Service property, so the applicant would have to get permission from the Forest Service to remove it. According to the Kutenai Indians, avoidance of particular places would not prevent loss of guardian spirits that would result if the dam were to be built (see Kutenai Religion section). It has been shown elsewhere that monitoring only records the vandalism and destruction of sites, unless enforcement is provided. Artifacts recovered from federal land are the property of the U.S. Government, and the applicant would have no authority to arrange their curation with the Kutenai Indians. Control of artifacts found on private land could be negotiated, but archaeologists suggest that all artifacts found in the district be kept together for scientific purposes.

The cultural resource plan the applicant is to develop could be approved by FERC, Board of Natural Resources and Conservation, and by the ACHP. The basic items in the plan would be a research design detailing the most important questions about the history and prehistory of the falls and vicinity, and specifying the methods to be used in answering these, and the stipulations that would be placed on any protective measures to be implemented on the portage trail and National Parks Highway and on any excavation.

If a data recovery program were initiated, it still would result in an adverse effect inasmuch as it would not result in a full recovery of scientific information, and data recovery techniques would constitute a form of destruction. The ACHP procedures for review of proposals for treatment of archaeological properties (FR 45:230; November 26, 1980) indicate that adverse affects cannot be completely negated when sites that would be affected are"known or thought to have historic, cultural, or religious significance to a community, neighborhood, or social or ethnic group that would be impaired by its disturbance, or so complex, or containing such complicated data, that currently available technology, funding, time, or expertise are insufficient to recover the significant information contained in it."

The Kutenai Indians notified the ACHP that such conditions exist, and that adverse effects could not be mitigated because the project would destroy their traditional campsites and sacred vision questing places (see Appendix A and Kutenai Religion section).

It is not certain how much information could be obtained through excavation. Archaeologists working in the reregulating dam area have been unable to develop methods to deal with mixing of cultural layers caused by burrowing mammals and forest fires (Roll 1981). Mixing of cultural layers may also be a problem at Kootenai Falls. Another hindrance to data recovery in the Kootenai valley is the lack of funds sufficient to adequately investigate the affected sites (Roll 1982). To determine the amount of funding needed for an adequate data recovery program, DNRC adopted the formula for calculating data recovery costs estimated by Roll (1981) through his experience with excavation in the proposed reregulating reservoir. Incomplete data on site size makes it difficult to predict exactly how much it would cost to salvage the affected sites even if funds were unlimited. Approximate size is known for only 13 of the 20 sites within the direct impact area of the project. If the total amount of the applicant's proposed $50,000 budget to reduce historical and archaeological impacts were spent on excavation, it would recover data from approximately .04 percent of those 13 sites.

If the proposed project were a federal project, the Reservoir Salvage Act of 1960 (PL 93-291 as amended) would limit expenditures for archaeological salvage to 1 percent or less of the project cost, unless Congress specifically appropriated additional funding. For the Kootenai Falls project, a salvage budget equal to 1 percent of project cost ($2,254,000) would permit excavation of less than 2 percent of the estimated volume of material potentially containing cultural remains that would be inundated or affected by construction. The adequacy of a partial excavation program is measured not by the amount of the site studied, but by whether the data gathered is sufficient to permit archaeologists to interpret the activities that once occurred there, and when in the past it was inhabited. Generally the minimum data needed to permit such an interpretation is in the 20 to 40 percentile range (Adams 1973). Little is known about the Kootenai region prehistory, no cultural chronology has been established, and there are many questions to be answered.

KUTENAI INDIAN RELIGION

EXISTING ENVIRONMENT

The Kutenai Indians have occupied the Kootenai River drainage (figure 1-1) all during recorded history and for an unknown period before that. Most Kutenai settlements are still along the river today except for the Libby-Jennings Band which was relocated from the project vicinity to the Flathead Reservation by the Treaty of Hellgate in 1855. The Kutenai living in Montana, Idaho, and British Columbia are engaged in a legal proceeding before FERC to oppose authorization of the proposed dam.

The falls area has the utmost religious significance to the Kutenai Indians, who believe that the creator and his divinities reside there. The falls are believed to have been selected and consecrated by the creator as a place where the Kutenai may go to receive visions, and is considered most sacred. The vision questing or consecrated area includes the falls as a whole, the rocks and the water, plants and animals, on both sides of the river approximately 3 mi upstream and 3 mi downstream (Moore 1981).

Unlike Christians, the Kutenai neither proselytize nor share their faith with others. To reveal the nature of their relationship with the guardians is comparable to giving away one's soul (Lefthand 1981). The Kutenai therefore are unwilling to disclose the specific religious significance of the falls. The general statements presented here are from the Kutenai and ethnographers who studied them in the past.

Turney-High (1941), studied the Kutenai in 1939 and 1940 and described them as a vision questing people. According to his study, their life-long dependence on guardian spirits began at an early age. Children were encouraged to go alone into places where the spirits dwelt in order to receive a guardian spirit. A spirit would appear to the child in the form of a vision, and would instruct it on how to conduct its life. The spirit would teach songs and dances, and would give its wisdom and power to the individual (Turney-High 1941; Johnson 1969).

Traditional vision questing places were selected by the spirits, and were used by succeeding generations of Kutenai. Such places were often marked by caves, islands, or lakes, and some contained paintings on the rocks (Schaeffer 1930s - 1960s). The Kutenai say that few such sites now exist (Moore 1981). Researchers of Kutenai culture have found references to several vision questing sites, but Kootenai Falls is not mentioned among them (Theodoratus 1981).

A ceremonial site examined by archaeologists at Kootenai Falls contained shell pendants, beaver and elk teeth pendants, bear claws, ornamental objects, ochre and trade beads, any of which could relate to vision questing activity. This site has not yet received sufficient archaeological evaluation to precisely determine its use (Davis, C. 1982). Only a few other comparable ceremonial sites have been recorded in western Montana. These include a site near Flathead Lake where artifacts were found on a narrow ledge beneath a rock face painted with pictographs; the Ram's Horn Tree in Ravalli County where the Indians left gifts; and the Bearmouth pictograph site east of Missoula, which also included a rich variety of ornamental artifacts (Flint 1977, 1981; Taylor 1981; Davis, C. 1982). With the exception of the Ram's Horn Tree, which has been protected by the Montana Department of Highways, the other ceremonial sites have been vandalized (Davis, C. 1982).

Five rock shelters at Kootenai Falls could also be associated with Kutenai vision questing, but the sites have received only superficial archaeological examination and the Kutenai have not said whether they used them. One of these is painted with pictographs and appears to match the characteristics of a vision quest site (Davis,C. 1982). Only two pictographs are reported in Lincoln County outside the project area. These are the Big Creek pictographs and the Gold Creek pictographs (Taylor 1981). Pictographs are believed to be where the successful vision seeker commemorated the spirit's visit (Keyser and Knight 1976).

The Kutenai faith is similar to other religions around the world that testify of visions, revelations, covenants and sacred places (Carrasco 1980). Even though all such religions are guaranteed the right to exist by the First Amendment to the constitution, Indians were discouraged from practicing their traditional religions; federal regulations in the late 1800s prohibited the use of traditional items of medicine or power, and in effect outlawed ancient ritual practices. While this federal policy was officially abandoned by the 1930s, specific recognition of Indian religious freedom is recent history. In Montana the 1977 Legislature officially recognized the Indians' religions and their freedom to practice traditional rites, and encouraged preservation and perpetuation of the Indian cultures (House Joint Resolution No. 32). In 1979, Congress passed the American Indian Religious Freedom Act (PL 95-341) which acknowledged the right of all Indians under U.S. jurisdiction to practice their religions and to have access to their sacred places. The Kutenai of British Columbia, while not protected by the above legislation, were guaranteed religious freedom by the Commission on Security and Cooperation in Europe (United Nations 1975) which provided"...respect for human rights and fundamental freedoms, including the freedom of thought, conscience, religion or belief." None of these acts is provided with an enforcement authority, but they demonstrate concern for assurances of religious freedom.

IMPACTS

The Kutenai say they visit the falls sacred area to receive a guardian spirit who guides and protects them throughout their life (Moore 1981). They also say that during one such visit the creator revealed to them that his home would be threatened, and he established a sacred covenant with the people requiring them to protect the falls. If the dam were built, the Kutenai believe they would be spiritually destroyed and the creator would not communicate with them or protect and guide them anymore.

REDUCTION OF IMPACTS

The terms of the Kutenai covenant do not provide for any compromises. The Kutenai could not arbitrarily change the location of the creator's home or agree to conditions under which the project could be built in the area. According to the Kutenai, construction of the project would cause the irretrievable loss of the Kutenai religion, culture, and way of life (Lefthand 1981).

KUTENAI INDIAN SUBSISTENCE

EXISTING ENVIRONMENT

The Kutenai say that up to 70 percent of their diet comes from subsistence foraging in and along the Kootenai River, and the project would impair their ability to survive (Echo-Hawk 1980 and 1981b). They claim that Kootenai Falls and the surrounding area, as their traditional homeland, is legally protected for subsistence activities. Near the falls, the Kutenai say, they have "hunted, fished, and gathered since time immemorial, and continue to do so today" (DeReitzes and Sugameli 1980). The Kutenai's rights to certain subsistence activities were confirmed in the Hellgate Treaty of 1855 (12 Stat. 975) in which they kept "the right of taking fish at all usual and accustomed places, in common with the citizens of the Territory together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land."

IMPACTS

The Kutenai, who traditionally relied on trout, whitefish, and sturgeon for subsistence and religious feasting, are concerned that fishing upstream from the falls would be eliminated by the reservoir and that dewatering and altered river conditions would harm downstream fishing. They expect waterfowl and wildlife, especially lion, bobcat, mule deer and whitetail deer, which they traditionally hunt, to be decreased by the project. They also expect to lose serviceberries, chokecherries, and huckleberries which they have picked for centuries in the area (DeReitzes 1980; Moore 1980; Enderson 1982). The Kutenai hold that the state may not take actions which abrogate a federally protected treaty right to fish, or that would cause adverse environmental effects on the fishery resource (Echo-Hawk 1981a).

REDUCTION OF IMPACTS

Should the dam be authorized, one Kutenai attorney suggested the applicant be required to supply the Kutenai with protein food to mitigate the loss of subsistence sources (Echo-Hawk 1980).

The Kutenai claim that their subsistence practices are intimately tied to Kutenai religion, culture, economy, and the environment, and the expected loss of fish used for traditional religious feasting could not be avoided or reduced if the project were built (Echo-Hawk 1980).

WATER RIGHTS AND USE

Montana water law (Section 85-2-301, et. seq., MCA) requires that any person or entity desiring to acquire a new water right or supplemental or additional water must apply for, and receive, a Beneficial Water Use Permit from DNRC before appropriating water or commencing construction of a diversion, impoundment, withdrawal, or distribution works.

The date of receipt of an application for a permit by the Department determines the date of priority for a water right when issued. The water use permit is by law a provisional permit subject to the final determination of existing water rights.

On February 28, 1975, NLI applied to DNRC (application no. 4,955-s76D) for 24,000 cfs, not to exceed 10,503,860 af a year, to be used for hydropower generation from January 1 through December 31 each year.

DNRC subsequently accepted NLI's application for a water use permit as correct and complete and informed the applicant that public notice (required by Section 85-2-307, MCA) of the application would be made each week for three weeks beginning April 16, 1982, through newspapers in the project area. Holders of water rights that might be affected by the proposed appropriation were notified by mail. Persons who believe their water rights might be adversely affected by the proposed appropriation could file an objection to the application on or before June 4, 1982, the objection deadline specified in the Public Notice to Water Users, as published in the newspapers. If objections are filed and a solution cannot be worked out, DNRC will schedule a hearing so all parties can present their evidence and testimony, and the hearing officer will issue first a proposed order for review and comment by all parties and then a final order. In compliance with this order, DNRC will either grant the permit as applied for, or grant it under specified conditions, or deny it. The final order can be appealed to district court within 30 days.

EXISTING ENVIRONMENT

The water right records indicate that the bulk of water uses along the Kootenai River in Montana are upstream from Kootenai Falls along the mainstem of the Kootenai and its tributaries. These water rights have priority over the NLI application and must be satisfied before water is available to the applicant (Guse 1981).

The Kootenai River in Lincoln County has six major uses, including domestic and industrial water supply, wastewater disposal, power production, recreation, and irrigation. The water consumption of these sectors is not currently known.

IMPACTS

One concern regarding water rights is the possible effect on future upstream consumptive uses. It appears that granting the water right requested by Northern Lights, Inc. could preclude any future industrial, domestic or agricultural uses. However, this possibility is not a consideration in determining whether to grant the water right (Guse 1981). (The criteria used to determine whether the water right should be granted are listed in appendix B.)

DNRC studied the potential for future irrigation, upstream from Kootenai Falls. A total of 3,662 arable but currently undeveloped acres was identified. If this acreage were used to grow grass, hay or alfalfa, it would require between 7,324 and 8,056 af per year. If Northern Lights receives the water use permit it applied for, water would not be available to irrigate these acres.

Flow records indicate that nonconsumptive use at Kootenai Falls would not adversely affect any water right holders downstream from the dam.

CANADIAN DIVERSIONS

One influence on the use of Kootenai River water is a Treaty between the United States and Canada, allowing the Canadians to divert major amounts of water from the river. The Columbia Basin River Cooperative Development Treaty of 1961 provides for diversion in three stages. The first diversion would be at Canal Flats in Canada, approximately 100 mi north of the international border, and could take place in 1984. It would take up to 1,500,000 acre feet of water, with the requirement that at least 200 cfs must remain in the Kootenai channel immediately downstream from the diversion.

The second diversion could take place in 2024, with the location of the diversion and the amount of water that could be taken left unspecified, but with the requirement that 2,500 cfs or the natural flow, whichever is less, be allowed to remain in the river at the border.

The treaty terms allow a third diversion in 2044, which would reduce the minimum in the river at the border to 1,000 cfs or the natural flow, whichever is less.

Average annual flows at the border are 10,520 cfs. The first diversion would reduce this by about 20 percent, the second would take another 56 percent of the original, with the third accounting for 14 percent. The third diversion would be beyond the expected life of the proposed dam.

IMPACTS OF THE CANADIAN DIVERSIONS

The likelihood of these diversions occurring is not known. Much of the engineering for the first diversion has been done and the EIS for this project is scheduled to be issued in June.

The electric generation calculations in the application for the proposed project were made on the basis of the assumption that the 1984 diversion would occur. The effects of the second and third diversions were not considered. DNRC calculated the potential power generation, that would result if none of the Canadian diversions were to occur, as discussed in chapter five. The effects of the last two diversions have not been calculated, but would reduce generating capacity of the river flow remaining after the 1984 diversion by roughly 59 percent and 74 percent.

AIR QUALITY

The Montana Department of Health and Environmental Sciences has authority over air quality matters, and this section was prepared by that department (Keltz 1981).

EXISTING ENVIRONMENT

Particulate is the only air pollutant monitored in Lincoln County. It is measured in suburban and industrial areas in the county, and the findings have little relevance to the site at Kootenai Falls. Smoke from forest fires is a periodic contributor to air pollution, as is the increasing use of wood stoves, which is having a major detrimental effect on air quality in western Montana.

IMPACTS

Construction operations that could affect air quality include drilling, blasting, rock crushing, hauling materials, making concrete, miscellaneous construction activities, and storage of excavated materials. Particulate matter would be the primary pollutant, and the crushers, the concrete plant, and the haul roads would be the primary sources.

Even under the worst conditions, the projected particulate emissions would cause pollution concentrations no more than approximately one third of the state's 24-hour limit.

Particulates at such low concentrations would not be expected to damage health or property, but might attain nuisance levels if not controlled.

Low concentrations of pollutants would result from vehicle exhaust and blasting. Estimates by the Montana Department of Highways (see Highway Engineering and Safety) indicate that each of the 12 diesel powered 10-cubic yard trucks the applicant expects to use would consume 37 gallons of fuel per 8-hour shift. Exhausts from all 12 trucks would produce the following pollutant emissions.

	pounds per hour
Particulates	.73
Sulfur Dioxide	1.57
Carbon Monoxide	16.13
Hydrocarbons	2.59
Nitrogen Oxides	11.70
Aldehydes	.17
Organic Acids	.17

These emissions would not violate any state or federal air quality regulations.

Projected emissions from blasting, based on the applicant's estimate that a maximum of 2,782,000 pounds of explosive would be used, indicate that 47 tons of carbon monoxide would be released, along with 12 tons of nitrogen oxides, and 1.4 tons of sulfur dioxide. These emissions would cause no air pollution problems outdoors, but would require adequate ventilation in the underground workings. Such ventilation would be necessary to remove particulates released by blasting and vehicle exhaust.

REDUCTION OF IMPACTS

Any air quality permit issued to the applicant would require compliance with the emission standards and ambient air quality standards of Montana. Further, under regulations as specified in the Administrative Register of Montana (16.8.1101) the applicant would be required to employ the Best Available Control Technology (BACT). BACT would require that particulate emissions from project-related air pollution sources be reduced substantially below the levels they would reach without controls, as shown below.

1) Rock crushing: 80 to 90 percent
2) Haul roads: 50 percent
3) Concrete plant: 80 percent
4) Storage piles: 50 percent
5) Miscellaneous construction activities (such as operation of construction equipment): 50 percent
6) All sources of particulate emission would be required to meet 20 percent opacity or less (Administrative Register of Montana 16.8.1401).

Emission reduction strategies probably would consist primarily of the use of sprayed water or chemical dust controls to retard dust. The applicant has agreed to spray water as necessary.

SAFETY OF VISITORS AND WORKERS

EXISTING ENVIRONMENT

The area around Kootenai Falls has natural and man-induced hazards. The banks of the Kootenai River near the falls are steep and in some places vertical, and the river channels are deep and swift. Throughout the written record of the area there are discussions of the dangers at the falls (Johnson 1969).

Since Libby Dam was built the river has been subject to flow fluctuations up to 2 ft per hr. Rapidly rising waters caused by discharges from the dam sometimes strand fishermen and visitors in the falls vicinity (Thorn 1981).

Twenty freight trains and two passenger trains pass along the Burlington Northern tracks on the south side of the proposed project area each day. Visitors wishing a close look at the falls must cross the tracks. The tracks make a sweeping bend as they pass through the project area, and in some places, approaching trains cannot be seen until they are quite near. The dangers of crossing the tracks are further increased by the noise from the falls, which makes it difficult to hear the trains.

IMPACTS

River flows at the falls and in the downstream canyon would become more hazardous to recreationists, in that a failure in the powerhouse could divert the entire river flow over the dam.

Safety hazards would be at their highest during the 4.5 year construction period (Rubich 1981). Day-to-day construction requirements would compete for available space with existing transportation and recreational uses to increase the already numerous dangers in the area.

Statistics show that heavy construction in Montana and the nation has a fairly high worker accident rate. The latest statistical data on heavy construction in Montana indicate an average rate of 12 reportable accidents per 100 employees per year. No fatality rates have been calculated for heavy construction in Montana, but nationally, 20 percent of the total work-related deaths in the last year reported were in heavy construction. A significant amount of the total work on the Kootenai Falls project would be underground, either tunneling or emplacing structures and equipment. Work in this environment is akin to underground mining and is subject to the same dangers. There is a possibility that the nature of the rock would cause hazardous conditions to workers. Rock of the type that would be tunneled through"is block like in nature and frequently has shear zones that are subject to slippage" (Armstrong 1981).

Train traffic would continue during construction and much of the above-ground work would be immediately adjacent to the tracks. The dam construction would require personnel to work in the river channel near swift, turbulent portions of the river. Rapid fluctuations in flow from Libby Dam could endanger workers in low-lying areas (Rubich 1981b). Finally, worker use of the area for recreation during nonwork hours is likely to temporarily increase the amount of recreational use, which could increase recreational accidents in the area.

Construction activities also would increase the possibility of railroad and highway accidents. Construction along the railroad right-of-way and haul roads crossing the railroad tracks greatly increase the potential for collisions between passing trains and construction equipment.

REDUCTION OF IMPACTS

The applicant said two exit routes from subsurface facilities would allow safe escape of workers if an underground rockfall or other accident made evacuation necessary. These escape routes would be the access tunnel and the bus shaft through which the transmission lines would go from the powerhouse to the overhead powerlines. The rock jointing in the tunnel area is said to be such that earth movement probably would not block both routes.

The applicant said the placement of the power station underground would virtually eliminate the risk of mechanical or shock injury to visitors. Visitor access to dangerous areas in the powerhouse would be prohibited by the applicant.

The applicant has made numerous proposals to protect the safety of workers, visitors, and those passing through the project area during construction. These proposals indicate that worker safety would be accomplished primarily through adherence by contractors to the applicable occupational health and safety regulations. The applicant proposes to restrict visitation to hazardous construction and operation areas, including the vicinity of the crest of the falls, the discharge portal, and the entrance to the access tunnel.

To protect visitors near the falls and downstream canyon from the water level rise that would occur in the event of a powerhouse failure, warning signs could be conspicuously (but judiciously) placed, and supplemented by warning sirens, one at the dam and more (if needed) downstream to be plainly audible throughout the area of the hazard. Signs would warn of abrupt water rises and instruct visitors to seek higher ground immediately upon hearing the warning siren. The sirens, of course, would have to be powered by a backup power source to be effective, and signs would require adequate maintenance and replacement.

The applicant could consult with the Safety and Health Bureau of the Montana Department of Labor and Industry and the Forest Service on design, placement, and maintenance of the signs. The warning system could intrude on the present freedom of recreation visitors, but would be a good compromise between attempts at absolute safety (which is impossible anyway) and losses in recreation quality. The estimated cost of this action would be $30,000.

A safety improvement would be provided by the railway underpass; visitors would no longer have to cross over the tracks. A log boom above the intake would prevent boaters from drifting over the dam.

It would be important to leave the swinging footbridge in place so that visitors would not attempt to wade or jump across the river channel to reach the north shore. The footbridge, recently inspected for safety by Forest Service engineers, subsequently underwent maintenance and was rated as safe. The bridge life is limited and will need replacement in about 10 years, however (Spehar 1982).

HIGHWAY SAFETY AND ENGINEERING

The Montana Department of Highways is responsible for all state-maintained roads in Montana, and has authority to place restrictions on activities affecting the use and safety of such roads. All information in this section is from that department (Cromer 1982).

EXISTING ENVIRONMENT

U.S. Highway 2 passes through the project area approximately 600 ft south of the falls and probably is the most significant safety hazard in the vicinity. The section of this highway between Libby and Troy, including the stretch that passes the falls, is a narrow, heavily traveled, winding two-lane mountain road with poor sight distances and a high accident rate. In 1981 the Libby-Troy portion of the road carried an average of 2,000 vehicles daily, of which 10.5 percent were trucks. The statewide average daily traffic for Montana's rural primary road system is 1,100 vehicles daily.

The accident rate for the highway between Libby and Troy is 4.35 (accidents per million mi traveled) compared to the statewide average of 2.49 on primary roads. There were 185 accidents in the 15-mi stretch during the period 1979-1980-1981. This is the equivalent of 12.3 accidents per mi on this road segment in the 3-year period. The 1980 Highway Sufficiency Rating gives the Libby-Troy road a safety rating of 3 out of a possible 20, with 1 the most dangerous and 20 the least. With the accident rate almost double the statewide average for primary roads, Highway 2 between Libby and Troy is a dangerous section of road.

IMPACTS

As currently proposed, the construction of the project would affect users of Highway 2 primarily through traffic slowdowns and possible road damage caused by the use of the highway as a haul road. Approximately .9 mi of the highway would be used to haul excavated rock from the underground works to the disposal site. The hauling would be accomplished by 12 dump trucks with a payload of no more than 30,000 pounds each. These trucks would emerge from the 30 ft diameter access tunnel, cross beneath the highway through an underpass to the haul road between the highway and the railroad tracks, and proceed 500 ft west to an approach where they would turn east onto highway 2 at the rate of one every four or five minutes. The loaded trucks would then proceed approximately .9 mi east to the road approach leading to the disposal area for the excavated rock. The low speed of the trucks and their continual turning on and off the road would require reduction of the speed limit to 15 mph in the construction zone with an additional 35 mph zone beyond the construction area on either end. The Highway Department estimated traffic delays caused by use of the highway for hauling would be"substantial." If all the excavated rock were moved in trucks and there were no delays or work stoppages, it would require 295 24-hour days to remove the projected volume of rock.

Besides the rock-hauling trucks there would be other trucks moving concrete and material into the access tunnel from the project batch plant and construction staging area. The number of such trucks would be somewhat less than the number of rock-hauling trucks, but still significant. For example, some of these trucks would move the 160,000 cubic yards of concrete that would be needed.

The added truck traffic on Highway 2 could accelerate deterioration of the road surface and increase the need for maintenance on this stretch of the road. If this were found to be occurring, the Department of Highways could require the construction contractor to use smaller, single-axle dump trucks with a capacity of 6 cubic yards or 18,000 pounds. This would extend both the construction period and the traffic delays. Another possible source of delay is the road icing that occurs on Highway 2. If the Highway Department were to determine that icy road conditions were causing safety problems in the project area, the road could be closed until the situation was corrected. Closures could last as long as 24 hrs at a time.

The combination of reduced weight allowances and substantial delays to traffic could cause long haul trucks and other through traffic to find alternative routes. Besides the potential for impacts from hauling on the highway, it is doubtful whether there is room enough to turn large trucks from the access tunnel road onto Highway 2 unless elaborate construction methods such as reinforced earth walls or metal bin walls were used in building the approach.

Other impacts related to highway safety pertain to the effects the project would have on the plan to eventually rebuild the highway. The Highway Department expects to rebuild the section near the proposed project, but is concerned that the blasting and use of heavy earthmoving machinery might be hazardous to the underground works of the proposed hydroelectric project.

REDUCTION OF IMPACTS

One of the most feasible methods of reducing impacts would be to excavate the access tunnel at the site originally proposed but to use a conveyor rather than trucks to move the excavated rock to the disposal site. This method would not be feasible unless the cliff that restricts sight distance at the originally proposed tunnel location were removed. Removal of this cliff would be less disruptive environmentally and more economical than the applicant's current plans, and would make it possible for the eventual highway reconstruction through the area to be carried out without heavy blasting that could be dangerous to the underground works.

The conveyor corridor would begin at the original access tunnel entry site, cross to the north side of the existing highway and remain between the highway and the railroad tracks until passing over the tracks near the proposed disposal site. The conveyor would be supported by steel structures mounted on concrete pads. A conveyor corridor probably would not be wider than 10 ft and could be designed to operate with little disruption of the surrounding environment. Two belts could be operated one above the other on the same support structures, with one moving concrete from the mixing plant to the tunnel, and the other moving the excavated rock to the disposal site near the mix plant.

Operation of the conveyor system would eliminate the need for using dump trucks once the actual tunnel excavation was started. Twelve tandem axle dump trucks operating 24 hours would consume an estimated 1,332 gallons of diesel fuel daily or 392,940 gallons over the life of the project, but the conveyor belt could be operated with electric energy, which would result in an estimated energy saving of about ⅓ .

An electrical transmission line near the site could be adapted to provide electricity to run the conveyor belt. Current plans include use of transformers at both ends of the project site. When there was no further use for the conveyors, they could be dismantled, and the concrete pads could be removed and the ground revegetated.

Another possible cost-effective alternative would be the removal of all the material through the water intake tunnel. An underground conveyor system could move the excavated material out the inlet tunnel to the surface, where it could easily be conveyored to the disposal site.

Tunnel grade would not be too steep to allow excavation from the intake toward the powerhouse and outlet tunnel. This method would eliminate the need for a long conveyor corridor on the ground surface, and eliminate the need for highway and railroad crossings. Surface disturbances would be confined to the immediate area of the dam and tunnel entrance. The area to be used for disposal and storage of the excavated rock is planned to be near the tunnel entrance, which therefore is the logical site for the extraction of the excavated material. This method would avoid many adverse conditions and thus would reduce the overall project cost substantially. The applicant said it would not specify the construction methods that would be used, but would allow the contractor to engineer his own plan. Given the advantages of the conveyor system, it is likely that the contractor would select it rather than hauling with trucks, but this would not be decided until after contracts were let.

Post-license engineering and planning forces the Department of Highways to assume the worst-case situations would arise, and to request conditions on the Board of Natural Resources certificate to ensure the least environmental impact on the highway. Failure to impose such conditions could result in public safety hazards and damage to the surface of the present highway.

The Department of Highways suggests the following conditions that could be imposed:

1) The applicant could be required to drill enough test holes in locations approved by the Montana Department of Highways to allow discovery of rock conditions that might affect the highway.

2) The contractor could be required to provide a qualified explosives engineer to act as an advisor and consultant to the contractor during drilling and blasting to ensure that blasts would not damage the highway or cause the rock cliff to the south to collapse on the highway.

3) The contractor could be required to monitor all blasting and furnish seismic or other devices to record actual particle velocity. A copy of each blasting record would be submitted to the Highway Department. A typical blasting monitor such as the BR-2-3 Blast Monitor distributed by Dallas Instruments, Inc. of Dallas, Texas would be acceptable.

4) Proper insurance or bonding could be required to guarantee the safety of the construction and the contractor's liability for any damage to the highway or public travelers from blasting.

5) The contractor could be held responsible for any and all damages he inflicts to the highway during his blasting operations.

6) The applicant could be required to adhere to the Highway Department regulations regarding road approach standards for access road approaches and parking lot approaches.

7) The applicant could be required to agree to absolve the Department of Highways from blame for any damage to the project resulting from blasting during the reconstruction of Highway 2 in future years.

8) The applicant could be required to provide for maintenance of the highway used for haul road purposes during construction of the hydroelectric project.

9) The applicant could be required to coordinate the proposed parking area pullouts with the design plans for the reconstruction of the highway, to ensure continued safe access.

10) To avoid roadway breakup and to minimize danger to the traveling public, the applicant and its contractors could be required to abide by Montana's gross vehicle weight (GVW) and size limitations and regulations for all project-related truck traffic on Highway 2.

11) The applicant's design and schedule for construction and installation of the access tunnel box culvert under Highway 2 could be submitted for approval by the Montana Department of Highways. The applicant and/or its contractor could be required to pay the Highway Department for all Highway Department costs associated with the access tunnel underpass, including, but not limited to, preliminary engineering, inspection, roadway reconstruction and surfacing, signing, and general and administrative overhead.

12) The applicant could be required to submit all proposed utility relocation on or within Highway Department right-of-way for approval by the Highway Department. The applicant and/or its contractor could be required to reimburse the Highway Department for all its costs associated with utility relocation caused by the project.

13) Any road or lane closure of Highway 2 to accommodate project activities could be required to have the prior approval of the Highway Department. The applicant and/or its contractor could be required to reimburse the Highway Department for all Highway Department costs associated with project-related closures of Highway 2 or either of its lanes.

The Montana Department of Highways could monitor compliance with these stipulations during the project construction.

NOISE

EXISTING ENVIRONMENT

The major noise source in the vicinity of the proposed project is the falls. The volume of the roar from the falls varies with flows, but at average flows is loud enough to muffle or obliterate the sound of passing trucks or trains so that they cannot be heard by persons on the railroad tracks or closer to the falls. The apparent loudness of these sources of course depends on the location of the listener.

IMPACTS

The reduction of flows over the falls to 750 cfs would essentially eliminate the sound of the falls. In the resulting quiet, passing trains and trucks would be much more noticeable than at present. The noise levels from logging trucks and diesel locomotives rank in the 100-125 decibel range, (Sewell 1979) and would echo and resound in the narrow canyon near the project after the project began operation.

Construction noise would be largely covered up by the sound of the falls and probably not audible when flows were above 15,000 cfs (Sewell 1979).

The blasting would all be underground except during the start of excavation, and probably would not be audible otherwise.

SOCIAL AND ECONOMIC CONCERNS

EXISTING ENVIRONMENT

The area studied to determine the social and economic effects of the proposed project is Lincoln County, with particular emphasis on the Libby-Troy area. Most of the people in Lincoln County live in the narrow valleys of the Kootenai River and its tributaries. Less than 30 percent of the population lives in the county's major towns, Libby, Eureka, and Troy. In 1980, Libby had a population of 2,748, Eureka 1,119, and Troy 1,088.

Libby and Troy, only 18 mi apart, are river towns, settled originally in conjunction with boat traffic on the river and the railroad that followed it. Eureka, 70 mi up the river from Libby, is the center of the county's only substantial agricultural region, the Tobacco Valley. The Eureka area is socially and economically distinct from the Libby-Troy area (WAI 1981a).

Libby and Troy are linked to the rest of Montana, and to Idaho, mainly by Highway 2 and the Burlington Northern Railroad. Kalispell, 89 mi east, is the nearest sizable city (1980 population about 15,000). Spokane, 165 mi west, is the nearest metropolitan area (1980 population about 171,000).

The demographic history of the Libby-Troy area follows from its economic history, often described as"boom and bust." The first "boom" occurred in the 1890s when the railroad was built along the river. The most recent boom came in 1968 when construction of Libby Dam brought an estimated 2,500-3,000 people into Lincoln County. In the years following the completion of Libby Dam in 1972, county population declined, so that the 1980 total (17,752) is approximately 2 percent less than the 1970 total (18,063), though still much higher than the 1960 level. Further information on population and economic conditions is available in Renne, Ward, and Owens (1981).

IMPACTS

A few of the many social and economic features of the study area were singled out in DNRC's analysis because of public concern about them and because they are most likely to be affected by the proposed dam.

Effects on Employment and Income

The Lincoln County economy is dominated by the timber industry, including logging, sawmill, and plywood mill employment. Construction and railroad employment depend largely on the wood products industry, and federal government employment is dominated by the U.S. Forest Service. Approximately 2,000 jobs are in wood products.

Mining is also important to the area, with about 200 persons employed at the W.R. Grace vermiculite mine northeast of Libby, and about 300 employed at ASARCO's copper-silver mine south of Troy. Tourism and agriculture are less important. Employment in the retail trade, services, and local government sectors derives largely from the"basic" employment categories described above, and provides upwards of 3,000 jobs (WAI 1981a; Renne, Ward, and Owens 1981).

The timber industry is characterized by seasonal unemployment and affected by national business conditions such as rate of housing construction and interest rates. As a result, unemployment rates are high in Lincoln County, usually double the state average. The major decline in the housing industry has caused a Lincoln County average annual unemployment rate of 15 percent or more since 1980, meaning 1,000 or more persons have been out of work on an average monthly basis (DLI 1981, 1982). This compares to the 1981 statewide average unemployment rate of about 7 percent (DLI 1982).

During the first quarter of 1982 the unemployment rate in Lincoln County rose from 16 percent in January to to over 37 percent in March. The rate dropped to 26 percent in April, but additional layoffs occurred in early May (DLI 1982). Such high unemployment indicates severely depressed economic conditions. The peak national unemployment rate during the Great Depression was 25 percent.

The occupational structure of Lincoln County reflects the dominance of the timber industry. A greater percentage of Lincoln County workers than workers in the state as a whole are in skilled trades or operating heavy equipment. The limited data available on the occupation composition of the unemployed suggests that between one-half and two-thirds are craftsmen, laborers, or operators (WAI 1981a; FERC 1981; Disbrow et al. 1981). Many of these individuals have skills qualifying them for dam construction employment.

Women workers are less likely than men to benefit from dam construction employment. Women held only 14 percent of the jobs in manufacturing, construction, mining and transportation which provide about 50 percent of total Lincoln County employment (DLI 1981).

If construction on the Kootenai Falls project were to begin in June 1984 (Sewell 1981), employment on the project would be expected to peak at 503 workers in the second year of construction (HARZA Engineering Company 1981). HARZA projected average monthly employment on the project during the second year would be 480, and during the third year, 482. Table 4-8 shows the estimated employment on the project and in new jobs created during each year of construction, for county residents and incoming workers. These estimates agree with FERC's that approximately 50 percent of project employees would be local residents or commuters.

TABLE 4-8. ESTIMATED EMPLOYMENT ASSOCIATED WITH KOOTENAI RIVER HYDROELECTRIC PROJECT

	Monthly Averages				
	Year 1	Year 2	Year 3	Year 4	Year 5
Total Direct Employment	205	480	482	273	53
County residents	76	177	178	101	20
Incoming workers	109	255	256	145	28
Commuters	20	48	48	27	5
Total Secondary Employment	19	54	75	70	57
County residents	13	39	60	61	55
Incoming workers	6	15	15	9	2

Note: *Secondary employment refers to new jobs created by the project in the retail trade and service sectors; direct employment refers to project construction. Estimated employment is based on the assumption that 41 percent of the workforce would be current county residents, 10 percent would be commuters from nearby counties, and the remainder would be newcomers (Parcels and Shillington 1981).*

Source: *Total direct project employment figures are from HARZA (1981); the other figures are from Parcels and Shillington 1981.*

In the short-run, an estimated 178 local people, mostly men, would find construction employment for as long as two years. Another 60, mostly women, would find new jobs in trade, real estate, insurance, government, and other ancillary industries (Parcels and Shillington 1981). Some analysts do not expect measurable secondary employment increases during temporary construction projects (WAI 1981a). Thus, the secondary employment figures may be somewhat higher than would actually occur.

Factors that are certain to affect local residents' share of dam-related construction jobs include the condition of the wood products industry at the time the project starts; status of the reregulating project; the role of unions in determining who is hired (an out-of-state contractor might bring his own employees, and/or workers might be hired on a seniority basis from multi-county or statewide union membership, rather than because they live nearby); and the terms of the contracts under which the work is performed (Disbrow et al. 1981). James A. Sewell and Associates, consulting engineers for NLI, said in March 1981 that"Northern Lights will encourage the Contractor to hire local workers, but will not be able to force the Contractor to hire local people" (Sewell 1981).

The project offers no long-term solution to unemployment in Lincoln County. If the Libby Dam experience is any indication, unemployment rates are not likely to fall much even during dam construction. During Libby Dam construction, unemployment rates in Lincoln County remained around 9 percent (FERC 1981) even though peak construction employment created 2,080 jobs (USCE 1978). The high seasonal unemployment rates associated with the wood products industry moderated somewhat during Libby Dam construction. However, WAI speculates that continued high unemployment rates may have resulted from a large influx of migrants seeking work on the Libby project, many of whom were not successful in obtaining employment. This phenomenon is common to large construction projects (WAI 1981a). The Kootenai River project is smaller than the Libby Dam project, and unless the reregulating dam were built concurrently, an excessive influx of job seekers is not as likely as for more widely-publicized large projects.

Operation of the dam will require a maximum of 20 workers, some of whom would be local residents (Sewell 1982).

The beneficial income effects of the project during construction would be proportionally greater than employment effects, because dam construction would create high paying jobs compared to the average before construction. These income effects would be small following construction, however.

Construction payroll and the much smaller contribution of payroll from new jobs created in the retail trade and service sector would range from a peak of $11 million in the second and third construction year to a low of $1.5 million in the final year of construction (Parcels and Shillington 1981). This compares to total 1979 county personal income of $140 million. At the peak of construction, the income generated would be a significant portion of total personal income in the county. However, it is not high enough to create much inflationary pressure on prices except, perhaps, on services used extensively by workers, such as temporary lodging and food and drinking establishments.

WAI estimated that local retail and service businesses as a whole experienced increased sales on the order of 10 percent as a result of increased construction worker income during construction of Libby Dam. The project at Kootenai Falls is smaller, and effects on businesses may not approach the 10 percent figure, except for those establishments providing services used extensively by workers.

Lack of information on contractors' purchasing practices prevents determining whether secondary income or employment would result. For example, if substantial local purchases of sand, gravel, cement, and concrete were made, local income and employment would increase.

Effects on Housing, Public Services, and Schools

If the dam is built, approximately 256 construction workers are expected to move to the Libby-Troy area, staying for approximately 2 years. Table 4-9 shows the total population influx (incoming workers and their families) expected during construction.

Following customary procedure, peak year estimates are used in predicting impacts on social structure, quality of life, schools, housing, public services and local government revenues and expenditures. The total influx for the peak year, above the preproject levels, is expected to be approximately 580 people (Parcels and Shillington 1981), or about 3 percent of the estimated total county population for the same year.

Based on the assumption that 256 construction workers would move to the Libby-Troy area, including 125 workers that would be accompanied by families, the housing demand is estimated at 215 units (Parcels and Shillington 1981).

There is a surplus of mobile home and trailer spaces in the area as a result of the expansion during Libby Dam construction. The scarcity of rental housing and the surplus of trailer spaces makes it reasonable to assume that most newcomers would live in mobile homes (a 1979 study counted 322 vacant mobile home sites). Some new housing con-

TABLE 4-9. ESTIMATED POPULATION INFLUX ASSOCIATED WITH EMPLOYMENT ON KOOTENAI RIVER HYDROELECTRIC PROJECT

	Number of People				
	Year 1	Year 2	Year 3	Year 4	Year 5
Incoming Construction Workers	109	255	256	145	28
Not Married	27	63	63	36	7
Married, Family Absent	29	67	68	38	7
Married, Family Present	53	125	125	71	14
Family Members					
Spouse of Worker	53	125	125	71	14
Children under 5	31	72	72	41	8
Children 5-13	44	102	103	58	11
Children 14-19	9	21	21	12	2
Children 20 or older	2	5	5	3	1
Total Population Influx	248	580	582	330	74

Source: *Based on an estimate of 49 spouses and 79 children for every 100 incoming workers (Mountain West Research 1975). These estimates refer only to Kootenai Falls project construction workers and their dependents. They do not include any population influx associated with secondary employment or with people coming into the area looking for work on the project but who do not obtain employment.*

struction might be stimulated by the project, especially since there is already a shortage of apartments in the area, but Parcels and Shillington estimate this increase would provide only 17 percent of the units. They expect mobile homes and trailers to meet 70 percent of the demand, and existing vacant houses another 13 percent (1981).

Libby, Troy, the Libby and Troy school districts, and Lincoln County are the taxing jurisdictions that would be affected by the project. All jurisdictions are currently in sound financial condition (WAI 1981a; Renne, Ward, and Owens 1981).

Public services were generally rated"average" or better by community residents in WAI's survey (1981a). However, sewage disposal and law enforcement might be affected by the project.

Sewage disposal in the study area consists of a primary treatment plant serving the city of Libby and septic tanks everywhere else. South Libby Flats groundwater is periodically contaminated by septic systems. Nevertheless, voters in the South Libby sewer district voted down a 1979 proposal to build a sewer system (linked to the Libby system), and groundwater contamination continues to be a problem there (HKM 1981). In Troy, substandard septic systems and occasional surfacing sewage have been identified as problems (DHES 1981). The county currently will not issue any septic tank permits for new buildings in Troy because the vacant lots are not large enough for an adequate on-site system. The lack of new housing in Troy encourages growth in outlying subdivisions (Weston 1981). The city of Troy has applied for Environmental Protection Agency (EPA) funding for a central sewage disposal system serving the incorporated areas of Troy (Weston 1981).

To meet state and federal standards, the Libby sewage treatment plant will have to be converted to a secondary treatment system. The city repaired its sewer lines in 1980 and has applied for EPA funding for the new plant, installation of which would occur in 1984 if funding is granted (Eldridge 1981). An additional facility will be needed to process septic tank sludge. The Libby City Council and the County Commission agreed in July that three-quarters of the local share of the cost of this additional facility will be borne by the county (Weston 1981). The existing facility cannot accommodate septic tank sludge so it is currently being dumped in ditches along Pipe Creek Road on city property (Eldridge 1981).

Like the septic-tank sludge disposal issue, the law enforcement issue is a product of Libby's inability to finance public services for the larger community on the basis of the incorporated city's tax base. The city council arranged to contract with the county for police services beginning July 1982, a move that would save the city $40,000 to $60,000 per year. This proposal was opposed by a citizen's group, and city-county consolidation of services remains controversial.

If the proposed dam is built, most newcomers would live outside the city limits of Libby and Troy, as this is where the trailer parks are located. If the Troy central sewage system is built, new housing expansion in Troy would be possible (Weston 1981). Otherwise few newcomers are expected in Troy because there are few vacancies.

Whether incoming construction workers and their families would add to the existing sewage problem would depend partly on where they live. An increased population in any of the sewage problem areas would increase the probability of on-site sewage system failures, and increase the potential for public health problems (Weston 1981). If most of the newcomers were to live in existing trailer courts with adequate septic tank capacity, or that have room to add new drainfields if septic tank failures occur, problems would be minimized (Anderson 1981).

Other than the potential sewage problem, DNRC agrees with FERC's conclusions that most public services are adequate to meet the demands of the population influx associated with the project, and that increased tax revenues from construction workers will, for the most part, cover the costs of increased personnel requirements. Libby could face a fiscal shortfall during the peak construction years when it will provide such services as law enforcement and street maintenance but receive very little tax revenue because most new workers will live outside of the town.

DNRC was unable to determine whether the population increase during dam construction would cause fiscal difficulty for Libby or if so, its magnitude. It would depend on the fiscal condition of the town at the time construction workers come, where they choose to stay, and whether there will be an influx of job seekers who are not successful in obtaining employment. Libby is currently in sound financial condition, although the long-term picture may be somewhat different. WAI projected that Libby's taxable value, as in many local jurisdictions throughout the state, would decline in the next 10 years. There would be a corresponding decline in real revenue (measured in constant dollars). As a result, either mill levies or rates for services might have to increase sharply, or both, if expenditures are to remain at current levels (WAI 1981a). If Libby has difficulty financing public services in the coming years for its existing population, the problem would likely be exacerbated during dam construction, particularly if workers place demands on town services but do not contribute to the town's tax base.

Schools in the Libby-Troy area have adequate capacity to accommodate the expected number of new students that would be associated with dam construction. Enrollment has declined by about 13 percent since 1970-71 in both Libby and Troy, and most schools are well below capacity (Waldron 1981; Cooper 1981). Surplus capacity in 1980-81 ranged from 75 students in Libby elementary schools to 300 in Libby Junior High School. The expected peak population influx would include approximately 124 school-age children, of whom about 73 would be elementary students; 30 would be junior high school students; and 21 high school students. Even if all the families with children chose to live in the Libby School District, these numbers would not exceed current school capacities. Miscellaneous tax revenues associated with new construction workers and increased revenues from the school foundation program as a result of higher enrollments are expected to be sufficient to cover the increased costs of new students (Parcels and Shillington 1981).

The proposed project would be in the Troy school district, which would be the principal beneficiary of new tax revenues paid by the project owners. The county would also benefit in the long run. However, a fiscal shortfall of about $30,000 is expected at the county level during the second year of construction, when necessary increases in service expenditures would exceed tax revenues. This shortfall is not expected to cause difficulty because of the sound fiscal condition of the county and because the shortfall is very small in relation to the total county budget. The shortfall could increase if there is a substantial influx of job seekers who do not obtain employment and require county welfare assistance.

New tax revenues during construction would include taxes paid on the value of construction equipment, vehicles and mobile homes, and on the value of the completed portion of the dam. The project will also generate increased federal and state income taxes, primarily during construction. Once the project is completed, total annual taxes paid to Lincoln County would be about $1.7 million (in 1981 dollars, using the 1980-81 mill levy), including approximately $1 million annually to the Troy School District, $170,000 to the county, and $500,000 to county-wide and state school funds. The applicant would also pay $103,000 per year to the state General Fund under the Montana Electrical Producer's Tax.

The most significant tax benefit is to the Troy school district. Its taxable value was expected to increase by $7.9 million, or 340 percent, when the ASARCO mine began operating (WAI 1981a). The substantial tax base increase is expected to relieve Troy and Troy school district residents of much of the current tax burden associated with schools. The proposed dam at Kootenai Falls would add another $6.7 million to the taxable value and reduce the tax burden further, resulting in lower taxes for residents.

The long-term tax benefit to the county is relatively small, amounting to about 1 percent of 1979 total county revenues (Parcels and Shillington 1981). When account is taken of the county's costs of providing services to the increased permanent population, the net annual county tax benefit would be about $75,000 (1981 dollars, Parcels and Shillington 1981).

EFFECTS ON SOCIAL VALUES AND SOCIAL CONFLICT

Settled first by transient miners and railroad workers far from the trade and communication centers of late nineteenth-century Montana, the northwestern part of the state still has its own subculture. Its central value is independence, defined as self-sufficiency, privacy, and a commitment to the work ethic (WAI 1981a, Montana Department of State Lands (DSL) 1978). Self-sufficiency, or the ability to provide for one's own needs, is considered a desirable quality for the community and for its residents. Government regulation is generally distrusted (DSL 1978), and people are reluctant to use social services.

WAI also found there was an appreciation of the natural environment. The land is valued,"not just for what it provides but for what it is" (WAI 1981a). Asked what they liked best about Libby or Troy, respondents in the Western Analysis survey were most likely to indicate the "natural environment" (86 of 123 respondents.)

Because independence is such an important value, economic development is a particularly sensitive issue in Libby and Troy. On the one hand, the consensus is that the area needs more jobs, and that development means jobs: on the other hand, many residents anticipate environmental deterioration as a consequence of development, and consider these costs perhaps too high (WAI 1981a). Some believe that development will bring in outsiders who will demand services that long-term residents will have to help finance and that development means social change at the rate and on the scale they associate with Libby Dam construction. In other words, the small uncrowded towns, the sparsely populated rural area, recreational opportunities, and the opportunity to be one's own boss — the qualities that people in the area value so highly — are threatened by new development, yet many people also believe that they cannot survive without it.

Most people DNRC interviewed in the summer of 1981, and many of WAI's informants also, said they expect economic benefits from the proposed project for their communities, if not for themselves. At the same time,"economic development at all costs is resisted. The people of Libby/Troy are troubled over the state of the economy and wish to do something about it, but not if it means damage to the environment and lifestyle they currently enjoy" (WAI 1981a).

Development projects have been controversial at least since Libby Dam was first proposed in the early 1950s (Spritzer 1979). In the last few years several major projects have been proposed, the proposed dam at Kootenai Falls, the reregulating dam, and additional units at Libby Dam. The combined effect of these proposals has been to polarize the local population — especially in Libby — over the development issue. Four organizations, the Save the Kootenai River Association, the Cabinet Resource Group, the Libby Rod and Gun Club, and Northwest Energy Employment and Development (NEED), have taken firm and diametrically opposed stands regarding the proposed dam at Kootenai Falls, and their members are prominent at hearings and among writers of letters to FERC, state agencies, and the *Western News*. The polarization over development has an adverse effect on community social cohesion and the value placed on the friendly, small-town way of life. As one person put it,"It's too bad. There are good people on both sides" (WAI 1981a).

DNRC's mail survey of Lincoln County residents (Allen, S. 1981), showed that they were rather evenly divided on the issue of hydroelectric development at Kootenai Falls. When asked to indicate their overall attitude towards the dam on a seven-point scale, the results were as follows:

Strongly Oppose			Neutral			Strongly Favor
27	11	7	16	10	8	20

Note: Total equals 99 percent due to rounding.

In all, 45 percent opposed the project, 38 percent favored it, and 16 percent were neutral.

The DNRC survey form included a blank page on the questionnaire for respondents to add comments. About 40 percent (190 persons) of the sample chose to write something, with many expressing a pro or con attitude toward the proposed dam. A representative look at these comments revealed the complexity of the issue and Lincoln County residents' perceptions of the many tradeoffs involved.

Many project opponents were concerned with adverse impacts on recreation and scenic quality:

I firmly believe that building another dam is totally unnecessary. The Libby Dam is enough. These days there is too much emphasis on destroying many natural beauties and wonders for the sake of "progress. It is high time for preserving areas like Kootenai Falls, and leaving it in its natural beauty without alterations.

Some respondents such as this retired wood products employee were also concerned with possible adverse effects on future generations:

I do realize of course, that all things cannot or at least do not stay the same forever. I also know that we need more power to make energy. Maybe it is wishful thinking, but I so wish that those who follow me in this life may see the true beauties of nature as I have been blessed to see them.

Many felt quite strongly about the falls:

I believe the destruction of free-flowing rivers in Montana to create power to smelt aluminum for beer cans in Washington state is a crime against nature and the people responsible for such crimes should be hung by their wrists and horsewhipped...If you'd provide another ten pages, you'd get a considerable earfull of what I think about this dam.

Even some proponents of hydroelectric power opposed a dam at the falls:

I really hate to see such natural beauty changed by anything artificial, however, I'd really like to be sure my kids aren't mutants or have to go through anything like Three-Mile Island just for energy's sake. I'm very much for water, solar, and wind power, but couldn't it be somewhere besides so beautiful a place as Kootenai Falls?

Dozens of respondents questioned why another dam was being proposed when the reregulating project was not yet decided. Most of those individuals favored completion of the reregulating dam, but opposed a dam at the falls. This seemed to be a widespread feeling, represented by the views of this construction pipefitter:

I think the Re-reg dam below Libby Dam is necessary. This should be built and belong to Northern Lights, Inc. There are many locations on the Kootenai and Yaak Rivers where power could be produced. Many people feel strongly about Kootenai Falls...The Re-Reg dam is necessary, Kootenai Falls dam is not.

One resident opposed the project because he felt the existing economic value of Kootenai Falls would be lost:

I am not a hardcore environmentalist. I am not a hippie type. I am not a radical. I work hard on civic projects in Libby. I do not belong to the Rod and Gun Club. In my opinion, there is an economic benefit to Libby the way the falls are now. There is a lot of $ in that flowing water for recreational purposes. There are always lots of people fishing the stretch of river above the falls. The flowing water, color, etc. are beautiful any time of year. The tourist industry is just beginning in this area. I look at the falls and river above the falls in two ways: 1) for its aesthetics; and 2) for its $ potential, and in that potential I do not see benefit in a dam.

In summary, opponents of the project cited many reasons for their attitudes. Proponents of the project, whose comments tended to be more brief and less heated, listed mainly the need for power and economic reasons for their support. Some put it quite simply, like this logger in his sixties:

The more people we have in our country the more energy we need to meet the demand. You can't live on fresh air and beautiful scenery.

One man expressed frustration at perceived opposition to development:

The country needs more power and where are we going to get it with environmentalists opposing every attempt to get it? We don't belive in destroying the country but there has to be some happy medium between the two groups.

For some, this frustration was more extreme.

Being a disabled construction worker, I know what it's like to look for work in this area...if we don't get more work around here, many will lose their homes, food from their children's mouths, and the shirts off *their backs. And if the environmentalists would shut their mouths and do something constructive they wouldn't have so much to [complain] about. I wish I had the money they spent in court.*

Others felt there were relatively few tradeoffs involved because of project design and the perceived minimal level of adverse impacts. Some also emphasized the benefits of hydroelectric power compared to other forms:

> *I'm a firm believer in the conservation of our natural resources. However, I strongly disagree with the "no growth or development at any cost" attitude that seems to dominate the thinking of some special interest groups in the Lincoln County area. This is not conservation. Obviously construction of the proposed Kootenai Falls dam cannot be accomplished without some changes to the natural setting. . . this doesn't mean that the beauty will be detrimentally altered. The project has been specifically designed to minimize, to the greatest extent possible, impact to the natural setting at the falls. I feel that there is a strongly demonstrated need for additional power generation in the Northwest. Of all the means currently available for obtaining this power, hydroelectric jprojects, such as the Kootenai Falls dam, are the environmentally safest and cleanest and have the least impacts on our nation's natural resource while being highly cost effective.*

The individual comments above have been selected to illustrate the extent and range of public opinion about the proposed project which has generated local social conflict. Social conflict is a frequent effect of any major development proposal, and is generally the first impact to be felt by a community. Unlike most other impacts, it starts when a project is proposed, rather than after construction begins.

If the dam at Kootenai Falls is built, the job opportunities and increased income and taxes from the proposed project would be economic benefits that the community as a whole desires, and which would improve the economic quality of life. Other important values such as the friendly, small-town atmosphere so often praised by Libby and Troy residents, would be adversely affected by an influx of newcomers. The general hostility to newcomers expressed by the people in the WAI survey, and the statements of concern about the adverse effects on the local community resulting from social conflict generated by the project, are indicative of the importance of this value to the quality of life.

On the other hand, as a result of the Libby Dam construction boom, many newcomers have recently been absorbed into the community. (One-fourth of DNRC's survey respondents reported that they came to Lincoln County during the Libby Dam construction period.) According to comments made by WAI's respondents, some residents would welcome newcomers. For instance,"The people who built Libby Dam were professionals — they were used to working for a living and they were skilled — These people brought in some good ideas. They were a good addition to the town" (WAI 1981a).

In addition to the community divisiveness caused by social conflict, the loss of the falls as a scenic and recreational resource would be a long-term adverse impact to the quality of life in the Libby-Troy area.

Except for the level of social conflict that has been generated by the proposed project, the socioeconomic effects would be small. Even if the reregulating dam were built concurrently, (see Cumulative Impacts section) annual population growth would not exceed 4 percent, less than half the peak annual growth rate experienced during Libby Dam construction. Expected expansions and contractions of the local economy in terms of employment, income, taxes, and expenditures, would also be small.

REDUCTION OF IMPACTS

It is likely that a fiscal shortfall of $30,000 will occur at the county level during the second year of construction. It is also possible that required expenditures for services in Libby during peak construction years may exceed new tax revenues. Some mechanism or group of people, such as a planning committee consisting of representatives from DNRC, the applicant, and local citizens, could be established to monitor the social and economic impacts of construction, so that potential problems can be identified early and solutions determined. The county commissioners could request prepayment of a portion of the project's taxes from the applicant, under Montana Code 15-16-201, or the Board of Natural Resources and Conservation could condition the Certificate to require the applicant to provide impact aid payments if the monitoring group determines they are necessary to cope with problems created by the proposed project.

The influx of construction workers to the area could be reduced, and corresponding demands on local government services could be reduced, if the

Board of Natural Resources and Conservation conditioned the Certificate to require preference hiring of local workers. Since nearly all social and economic impacts result from the influx of construction workers, a local training and hiring policy would reduce the impacts. It would also increase the benefits to the existing local population.

ENGINEERING

Any major construction project must meet the requirements of state and federal law. Usually, there are several different engineering approaches to each problem met in fulfilling these requirements, with no single best answer. In order to make the necessary choices, professional engineers have legal responsibility for the outcome of their work. DNRC engineers do not take major issue with any of the engineering procedures proposed for the Kootenai Falls project. However, they do have some suggestions, as follows.

REDUCTION OF IMPACTS

Normally, the automatic flow controls would maintain river flows more uniformly than possible with manual control. However, a malfunction of the system could cause the release of too much or too little water, which the underground powerhouse operators might not notice for a long time.

Therefore, the operation of the dam could be augmented by a gate position alarm that would sound in the operations center if flows were more or less than the appropriate levels.

CUMULATIVE IMPACTS OF THE PROPOSED PROJECT

The proposed project would add both favorable and adverse effects to the impacts from existing projects in the vicinity. It must also be examined in light of the possibility of additional hydroelectric development on the river in the future. The project with the most and biggest impacts, both adverse and favorable, is Libby Dam, with its 91-mi reservoir, 48 mi of which are in Montana. Libby Dam impounds half of the Kootenai River in Montana. At least four potential dam sites have been identified downstream from Kootenai Falls. Two of these were specified by the applicant as alternatives to the Kootenai Falls site. The site of the proposed reregulating dam is about 16 mi upstream from Kootenai Falls, and although the project funds have been withdrawn by Congress, it remains under the Corps of Engineers' active consideration.

Cumulative impacts may also affect a large region, as in the case of the proposed project, where development of Kootenai Falls would complete the man-made alteration of all the 21 falls on large rivers in the Northwest.

AQUATIC LIFE AND HABITATS

As partial compensation for Libby Dam's destruction of riverine fisheries, the Corps of Engineers has improved the fisheries in the remaining river by regulating flows through the dam to maintain temperatures and flows suitable for fish, by cleaning up sources of pollution, and by improving spawning channels and access to spawning areas downstream. The fishery resource has improved substantially as a result of this management. Recreational fishing use of the free-flowing river has steadily increased and the section just above Kootenai Falls is now one of the most heavily fished stretches of river in Montana. The impoundment of 4.5 mi and dewatering of another .8 mi of the heavily fished portion of the river would adversely affect the progress made in reducing the fishery impacts of Libby Dam. If the proposed Libby reregulating dam were built, only 32 mi of river would be available for further improvement. Eventually, additional dams might be built downstream from the falls (HARZA

1980), further reducing natural aquatic habitat.

The construction of each additional dam either on a tributary or the mainstem Kootenai further impedes fish movement and dispersal opportunities. This reduces management possibilities, and has serious implications for the Kootenai drainage fisheries in Idaho, British Columbia, and Montana.

The white sturgeon population in the Montana portion of the Kootenai River declined steeply after construction of Libby Dam. More dam construction probably would have severe impacts on potential white sturgeon recovery and on river trout fisheries, further limiting opportunities for future improvement. At the same time the demand for recreational fishery on the Kootenai is likely to increase.

WILDLIFE AND VEGETATION

As described in the sections on wildlife and vegetation, the proposed project would partly negate the attempt to compensate for wildlife losses caused by Libby Dam.

A total of about 24,000 acres of land was inundated by Libby Dam, including about 12,440 acres classified by DFWP as big game winter range and approximately 3,500 acres of bighorn sheep range (Brown 1979). Only 2,456 acres of replacement habitat were obtained to offset these losses, so each acre of replacement habitat actually represents about 10 acres of habitat that were inundated by Lake Koocanusa. Inundation of the portions of this replacement land adjacent to the proposed reservoir, together with vegetation changes resulting from elevated groundwater and increased soil saturation would preclude management of at least part of this land for its intended purpose.

It is likely that Libby Dam curtailed cottonwood regeneration for the entire downstream stretch of the river in Montana, since the elimination of flood discharges prevents creation of fresh alluvium which is most suitable for establishment of new cottonwoods. Thus, the loss of about 14 acres of habitat containing mature cottonwoods probably would be part of the permanent loss of cottonwoods downstream from Libby Dam.

RECREATION AND AESTHETICS

Inundation by Libby Dam caused substantial changes to the recreational and aesthetic character of the upper Kootenai valley. The opportunity for boating and fishing on 48 mi of free-flowing river was exchanged for the recreational opportunities associated with reservoirs. Impoundment of half the Montana segment of the Kootenai makes the remaining portion that much more valuable for those who prefer recreation on free-flowing streams. The falls vicinity is the focal point of recreation on the free-flowing portion of the river, with fishing and sightseeing most popular, and a high potential for whitewater boating in the area that would be either impounded or dewatered by the proposed dam.

HISTORY AND ARCHAEOLOGY

DNRC research indicates that the loss of cultural resources from existing and proposed dam on the Kootenai has been significant, and the cumulative loss adds to the magnitude of adverse effects that would resultfrom the Kootenai Falls project. Approximately 425 sites were inundated by Libby Dam, and only 14 of those were partially salvaged. The impacts of Libby Dam on cultural resources has been serious and the impacts of the proposed reregulating dam and Kootenai Falls dam would further hinder the preservation of sites. Little is known about the cultural history of the Kootenai River valley, and only a fraction of the original sites remain with the potential to yield that information. Sites excavated in Lake Koocanusa and the reregulating dam area contained considerable information that cannot be interpreted until the cultural chronology is established (Roll 1982). If the Kootenai Falls sites are destroyed or altered, too few sites would remain to determine the cultural history of the upper Kootenai River. Two sites in the Kootenai Falls area have recently been lost to erosion, and another 18 would be lost and two damaged as a direct result of this proposed project. Seventeen additional sites near the proposed project would become more susceptible to vandalism and theft as a result of the improved access that would be provided by the dewatering of the channel. Should the proposed reregulating dam be built, 40 sites would be destroyed, of which only seven have been investigated, and those only partially. Three of these sites have already been damaged or obliterated by construction of the haul bridge and geological exploration in the proposed reregulating reservoir area.

KUTENAI RELIGION

Libby dam inundated a large portion of the traditional Kutenai homeland, destroying traditional campsites and burial grounds. The Kutenai expressed their opposition to the reregulating dam, to the archaeological salvage project conducted by the Corps, and to archaeological investigations at Kootenai Falls, saying that further disturbance or destruction of their sites was unwarranted (Munsell 1981). The proposed dam at Kootenai Falls would further reduce the portion of their original territory that is in its natural state and would destroy the way of life tied to their religious beliefs surrounding the falls (Lefthand 1981).

KUTENAI SUBSISTENCE

Libby Dam destroyed traditional subsistence areas. The Kutenai say that operation of Libby dam has markedly decreased sturgeon productivity in the reach between Kootenai Falls and Kootenay Lake: the addition of the proposed project would "*. . .destroy or severely reduce the already threatened fishery resources in the river" (Echo-Hawk 1980).*

SOCIAL AND ECONOMIC CONCERNS

If the reregulating project were built at the same time as the Kootenai Falls project, the total population influx would be 1,247 people, and the housing demand would increase from 215 units for the Kootenai Falls project to 459 for the two projects combined (Parcels and Shillington 1981). This is substantially more than the number of vacant mobile home sites counted in Lincoln County in 1979.

If the reregulating dam is built concurrently with the Kootenai project, total dam construction employment would double, and more local people would be employed. The expected county fiscal shortfall during simultaneous construction would be about $60,000 (1981 dollars).

Under conditions of coinciding peak construction years, the influx of school-aged children to the Libby area could exceed the capacity of Libby elementary schools. Parcels and Shillington estimated that the influx would include approximately 150 school-aged children, 85 of which would be in elementary school. Sewage disposal and groundwater contamination problems would increase. Competition for housing could inflate rents and selling prices for local residents, and the higher demand for goods and services could cause local inflation.

If the two projects are built in succession, the county could experience a decade of construction activity, and housing and services would not be strained beyond that caused by either project alone. Increased investment in housing could be expected, along with a greater buildup of the service sector, more permanent job switching, a different pattern of population growth and of demand for local government services, and creation of a larger skilled labor force.

UNIQUENESS

As required by the Siting Act, DNRC assessed Kootenai Falls to determine if it were the only remaining one of its kind. If this were determined to be the case, then development of the falls would be the final step in the cumulative development of falls on major rivers in the Northwest.

If Kootenai Falls is indeed unique in this respect, then any adverse impacts to the resource would gain significance, in the same way that impacts to endangered plant or animal species are often viewed as more important than impacts to more abundant species.

This section presents the results of a DNRC inventory of waterfalls on major rivers in Montana and the Pacific Northwest (Idaho, Washington, and Oregon).

The inventory process had several stages. First, to obtain a base list of waterfalls, DNRC used two recent inventories of low-head hydroelectric potential sites in the four states (Gladwell et al., 1979; Tudor Engineering 1980). Waterfalls were added to this list from maps and supplementary sources. This initial list was sent to water resource experts from each of the four states. To further check on the accuracy and comprehensiveness of the list of waterfalls, individuals acquainted with each of the falls were questioned about the falls and whether he or she knew of any similar falls in their region. Based on their comments, a final list of waterfalls was developed (table 4-10).

Development of this table required definition of several terms:

Waterfall. The Encyclopedia of Geomorphology defines waterfall as"A very steep (commonly vertical) fall of some magnitude in a river course." It distinguishes falls from cascades, which are"A fall of only a few feet, or a succession of such falls," and rapids, which are "Less steep but sufficient to accelerate noticeably the rate of flow and maintain white water at all stages of discharge." Rapids and cascades were not included in the list of waterfalls, although in some cases the distinction was difficult to make.

Major River. Any river having a mean annual flow of about 4,000 cfs or greater (at the falls) was called a major river. The mean annual flow of the river at Kootenai Falls is about 13,000 cfs. The"major river" definition was therefore a liberal estimate of what would constitute a river comparable to the Kootenai.

Developed Waterfall. A developed waterfall was defined as being inundated by a dam, or having a dam immediately upstream from the falls close enough to be directly associated with the falls by someone viewing it from nearby, or a falls at which the flow has been directly modified or diverted by man-made irrigation channels, fish ladders, or similar water diversions.

TABLE 4-10. INVENTORY OF WATERFALLS ON MAJOR RIVERS IN THE PACIFIC NORTHWEST

STATE	RIVER	FALLS	APPROXIMATE FLOW (mean cfs)	DEVELOPED
Montana	Clark Fork	Thompson Falls	20,000	yes
"	Kootenai	Kootenai Falls	13,000	no
"	Missouri	Black Eagle Falls	7,900	yes
"	Missouri	Horseshoe Falls	7,900	yes
"	Missouri	Rainbow Falls	7,900	yes
"	Missouri	Great Falls	7,900	yes
Idaho	Snake	Twin Falls	9,800	yes
"	Snake	Shoshone Falls	9,800	yes
"	Spokane	Post Falls	6,300	yes
"	Snake	American Falls	7,500	yes
"	Snake	Upper Idaho Falls	6,000	yes
"	Snake	Idaho Falls	6,000	yes
"	Snake	Lower Idaho Falls	6,000	yes
Oregon	Willamette	Willamette Falls	15,000	yes
"	Deschutes	Sherar Falls	5,750	yes
"	Rogue	Rainie Falls	5,700	yes
"	Columbia	Celilo Falls	100,000+	yes
Washington	Spokane	Little Falls	6,604	yes
"	Spokane	Upper Falls	6,604	yes
"	Spokane	Spokane Falls	6,604	yes
"	Columbia	Kettle Falls	100,000+	yes

Table 4-10 shows that Kootenai Falls is the only undeveloped waterfall on a major river in Montana and the entire Pacific Northwest. There originally were 21 such waterfalls; only one now remains. For comparison purposes, the Yellowstone River at the falls in Yellowstone National Park has an annual average flow of about 1,300 cfs.

In conclusion, Kootenai Falls is unique in Montana and the Pacific Northwest.

CHAPTER FIVE. ALTERNATIVES TO THE PROPOSED PROJECT

DEFINITIONS

The material in this chapter makes extensive use of economic terms that are not in common use with the public. These are defined as follows.

Nominal costs and *nominal prices* are measured in terms of what a dollar was worth in the year in which they are incurred, and include effects of inflation.

Real costs and *real prices* are measured in dollars with the value they have in a given base year. In this document 1981 is generally used as the base. *Real prices* are *nominal prices* adjusted for inflation from the base year to the year in which the price is applicable.

Nominal interest rates are rates for loans which will be repaid in nominal dollars, and include an inflation factor. *Real interest rates* are net of inflation. For example, a 12 percent nominal interest rate during a period with 10¼ percent inflation is the equivalent of a real interest rate of only 1.6 percent. (This is calculated by dividing 1.12 by 1.1025, which equals 1.016).

Amortization payments are the principal and interest payments over the life of a loan. Typically, amortization payments are constant (in nominal dollars) over the loan life. Adjusting for constant rate of inflation will yield declining real amortization payments.

Energy output or requirements occasionally are reported as *kWh* (kilowatt hour) *equivalent*. The amount of any form of fuel or heat equal to one kWh may be referred to as a kWh equivalent. An *average kilowatt (kW)* is a convenient way of referring to large amounts of energy: it is equal to 8,760 kWh, which is the equivalent of one kW over the 8,760 hours in a year. An *average megawatt (MW)* is 1,000 average kW. The cost of electricity as it leaves a generating facility is *busbar cost*. The busbar cost plus the cost of shipping the electricity to the consumer (including transmission line losses and incremental transmission and distribution line costs), is its *delivered cost*. The cost of energy uses where it is generated or saved, as in conservation, should be compared to the delivered cost of energy from facilities that must ship their output. The cost of electricity from the proposed dam at Kootenai Falls is compared to that of energy from other alternatives to determine whether the energy costs from those alternatives, if built by the applicant, would be less than the energy costs from the proposed dam, if built by the applicant.

A resource is *cost-effective* if it produces energy at a lower cost to the owner than other alternatives. In this chapter resources are said to be cost-effective if they produce energy at lower cost than the proposed dam. This is a restrictive definition that ignores differences in external costs such as environmental damage or reduced recreational opportunities.

INTRODUCTION

The Montana Major Facility Siting Act requires DNRC to compare an applicant's proposed project with other commercially available alternatives that might meet all or part of the energy demand of the applicant's customers. The primary concern of this chapter is the cost of energy and the impacts from each of the alternatives. The alternatives are covered in three categories: conventional facilities (large-scale hydropower facilities, including the applicant's preferred and alternate sites, installation of generators at existing dams, coal-fired generation, nuclear plants, and large-scale wood-fired generation); energy conservation (methods for increasing energy efficiency in the residential, commercial, industrial, and irrigation sectors); and renewable resource facilities (alternatives using solar, wind, small-scale hydro, wood, garbage, heat pumps, or geothermal resources).

DNRC COST ESTIMATION METHOD

DNRC considered all costs associated with each alternative over its useful life: original cost, the interest on the loan, taxes, insurance, the cost of operating and maintaining the alternative (including interim replacement of parts), and where appropriate, the cost of fuel for the alternative. DNRC's method accounts for the general inflation rate, the interest rate paid by the applicant, and the rate of escalation of individual cost components. All alternatives are assumed to be financed with currently available subsidies amounting to about 3 percentage points. Thus, although DNRC assumes a nominal market interest rate of 15 percent (and an inflation rate of 10-1/4 percent), the cost of borrowing is assumed to be 12 percent. The real discount rate, net of inflation, is assumed to be equal to the real market interest rate, or 4.31 percent. (This is derived by dividing 1 plus the nominal interest rate by 1 plus the rate of inflation:

$$\frac{1.15}{1.1025} = 1.0431)$$

DNRC calculated the annual levelized cost of each alternative, which is essentially the average cost minus the effect of inflation (real cost) over the life of the alternative (Nordell 1982b). Dividing annual costs by the annual energy output yields the levelized cost of energy from an alternative, presented in mills/kWh (1 mill = $.001). All energy costs in this chapter are in 1981 dollars, that is, dollars whose purchasing power is consistent with the overall price levels of 1981. Use of levelized costs allows comparison of alternatives with different outputs, costs, and lifetimes. The estimated energy cost of the alternatives holds only for the particular assumptions used in the calculation. These levelized costs should not be compared to energy costs calculated with different subsidies (e.g., residential tax credits) or different assumptions about inflation. Also, the levelized cost cannot be compared to the cost the applicant must pay the first year a facility is operating. Levelized cost may be higher or lower than first year costs depending on the preponderance of costs subject to inflation.

CONVENTIONAL ALTERNATIVES

DNRC examined a number of conventional generating alternatives to the proposed Kootenai Falls dam. These included hydroelectric generating projects elsewhere on the Kootenai River as suggested by the applicant, an alternate dam height and pool elevation (1,990 ft above mean sea level, as opposed to 2,000 ft proposed by the applicant), various small hydroelectric projects, installation of turbines and generators at existing dams, participation in a large coal-fired generating plant, nuclear generation, and wood-fired generation. DNRC also evaluated several alternate minimum river flows for the proposed dam, other than the 750 cfs minimum proposed by the applicant.

APPLICANT'S ALTERNATIVES

When Northern Lights, Inc. applied to FERC for a license to construct and operate a hydroelectric facility at Kootenai Falls it proposed alternative dam site locations at Katka, Rocky Creek, Ruby Creek and O'Brien Creek, all on the Kootenai River downstream from Kootenai Falls. In its application to DNRC, however, it dropped Ruby Creek and O'Brien Creek from further consideration because of unfavorable geological conditions (HARZA 1980). Alternative dam sites are shown on figure 5-1. Table 5-1 compares the characteristics (including construction cost and power output) of the applicant's alternatives and the proposed dam. The applicant's alternative Kootenai River projects are, (1) a single dam at Katka, with a reservoir elevation of 1,868 ft, (2) a two dam project, with a lower dam at Katka (reservoir elevation 1,817 ft) and a dam at Rocky Creek (reservoir elevation 1,868 ft), and a second two-dam option with a lower dam (reservoir elevation 1,862 ft) at Rocky Creek, in conjunction with a dam at Kootenai Falls (reservoir elevation of 1,990 ft, rather than 2,000 ft as in the proposed project.

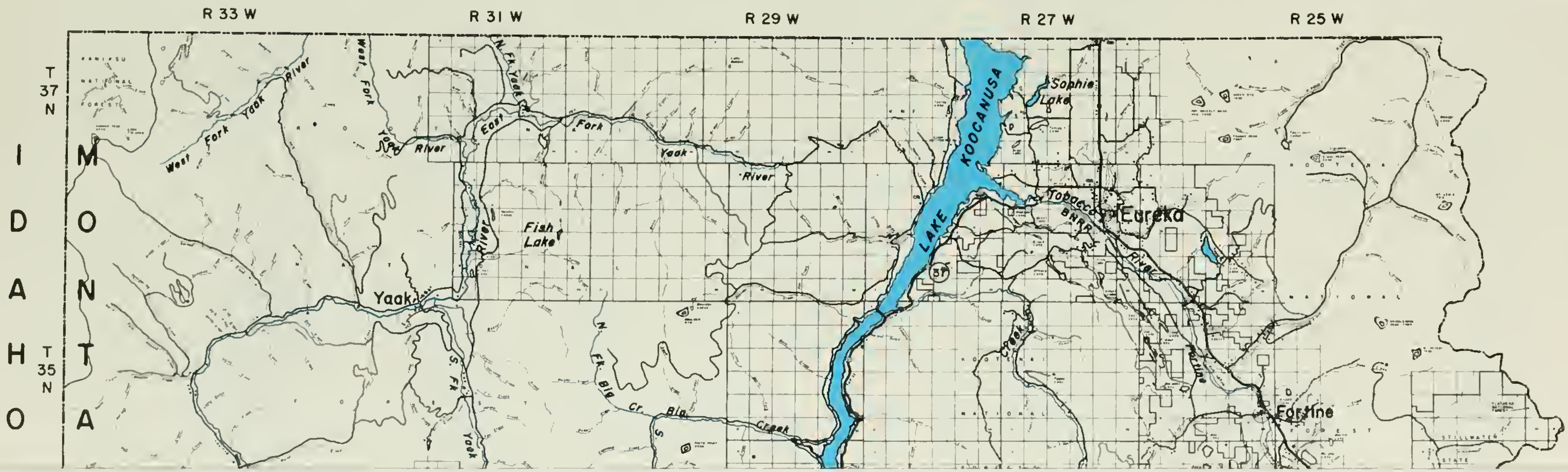
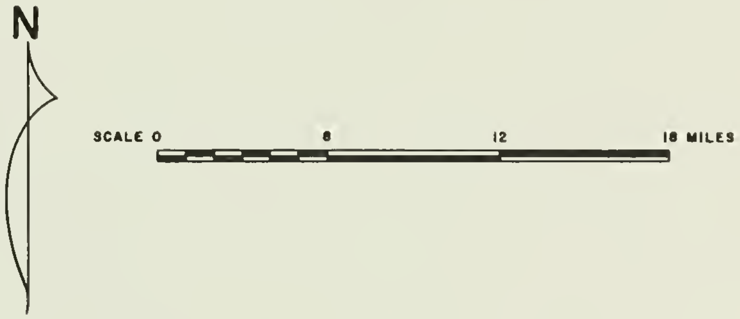


FIGURE 5-1. WMED'S ALTERNATIVE DAM SITES

1 Katka
2 Rocky Creek
3 Kootenai Falls



Source: DNRC

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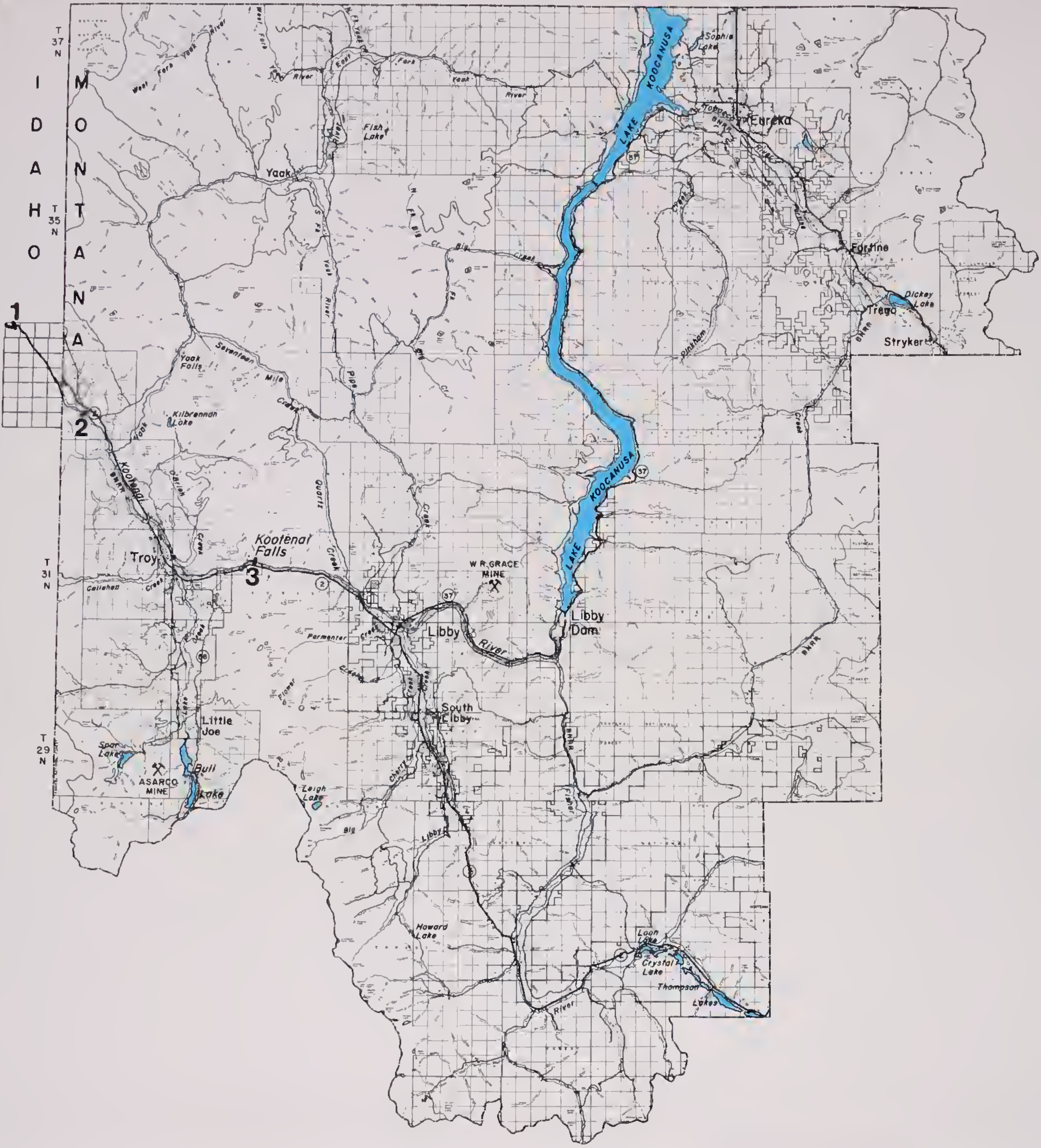

FIGURE 5-1. WMED'S ALTERNATIVE DAM SITES

1 Katka
2 Rocky Creek
3 Kootenai Falls

Source: DNRC

TABLE 5-1. WMED'S ALTERNATIVE PROJECT CHARACTERISTICS

	Project Location & Reservoir locaiton in ft above mean sea level*	Installed Capacity (MW)*	Average Annual Energy (million kWh)*	Dam Height (ft)**	Dam Length (ft)*	Gross Head (ft)*	Reservoir length (mi)*	Construction Cost (millions of 1981 $)*	Cost of Power 1st year mills/kWh***	Levelized Cost mills/kWh**
Alternative I (single dam)	Katka 1,862	138	540	81	675	81	18	375	87.20	32.39
Alternative II (two dams)	Katka 1,817	50	216	36	675	36	8	275	158.31	57.87
	Rocky Creek 1,868	80	323	51	700	51	11	192	74.82	27.90
Total		130	539				19	467	108.28	39.92
Alternative III (two dams)	Rocky Creek 1,857	59	244	40	700	40	10	164	84.58	31.36
	Kootenai Falls 1,990	125	457	20	925	79-96	2.3	218	60.48	22.84
Total		184	701			12.3	382	68.87	25.81	
Proposed Action	Kootenai Falls 2,000	144	515	30	925	89-106	3.5-4.5	232	57.28	21.64

* *Harza 1980.*
** *Alan, A. 1982.*
*** *Nordell, L. 1982b.*
(Assumes financing over 35 years, annual operation and maintenance costs of $3.85 per kW, administrative and general costs $1.58 per kW, first year taxes .504 percent of the capital cost, insurance and replacement costs of .17 percent of the cost of the plant.

Canadian diversions in 2024 and beyond have not been figured into the operating characteristics or the cost of power. Reduction of flow by the diversion in the year 2024 would cause a small increase in the cost of power from all the alternatives on the Kootenai River. Similarly, no attempt was made to account for the effect of sedimentation in making dredging necessary or in shortening the useful dam life.

ENVIRONMENTAL CONSIDERATIONS OF WMED'S ALTERNATIVES

GEOLOGY

Katka Site

At Katka the river has cut a steep-sided, relatively narrow canyon into the bedrock. The Leonia Fault passes about 1,500 feet from the proposed dam axis. Subsidiary faults (associated with the Leonia Fault) may exist in the area and considerable fracturing of the bedrock has occurred (Dalby 1981d).

Solid bedrock at this site is several hundred feet from the surface, which would require a very large structure to produce a small hydrologic head.

Rocky Creek Site

The Rocky Creek site lies about 1 mi from the Leonia fault and associated faults may lie hidden below the talus and other surficial cover of the area. The bedrock consists of strongly jointed and moderately fractured argillaceous limestone. Limestone is soluble and often contains solution cavities and open joints that can be difficult to seal. Some old landslides and a potential landslide hazard are thought to exist at this site. Depth to bedrock and its competence for the foundation and abutments is not known.

Seismic Risk

Northwestern Montana is not particularly prone to damaging earthquakes, and none has occurred in historic times in the vicinity of either of the company's alternate sites. However, the record is short compared to time involved in earthquake frequencies. Old faults, (such as the Leonia, a major nearby fault) may be reactivated in response to current adjustments in the earth's crust, so the presence of large faults should be considered in evaluating the seismic hazard of a site.

Adequate evaluation of the seismic risk and engineering requirements of each site would require more study if a dam were to be built there. However, enough of the geology is known to conclude that both of the alternate sites pose serious geotechnical problems that could make it difficult to design and build safe dams there (HARZA 1980).

FISHERIES

This comparison considers fish populations and movement and the size of the reservoirs that would be created. The same general types of impacts could be expected at all of these projects. All would create reservoirs with water retention times too short to provide good habitat for trout, whitefish, or white sturgeon. The river from Kootenai Falls downstream to the Idaho border is Class I (highest priority habitat for species of special concern) because white sturgeon, a rare species in Montana, inhabit this section.

Fish mortality and injury would result from dam operation at any of the sites, with the magnitude of the impact depending on turbine design and operation characteristics. (See discussion of turbine impacts in the Aquatic Life and Habitat section of chapter four).

Based on length of reservoir alone the Kootenai Falls project would have the fewest effects on fisheries simply because it would create the shortest reservoir (table 5-1). However, the relative value of the fisheries in each section also must be considered. Is it preferable to destroy 5 mi of an excellent trout fishery as would occur at the proposed project, or to eliminate two to four times that amount of a less valuable trout and whitefish stream as would result from any of the alternatives? Because of the difficulty of this question, DNRC evaluated sites on the basis of other considerations, as follows.

Based on the similarity of the river stretches that would be impounded, DNRC assumed that the fisheries that would be affected by the Katka and Rocky Creek dams are similar in quality.

Katka 1,862

This dam would block all the white sturgeon habitat in Montana and turn 18 mi of good trout and whitefish river fishery into a reservoir. It would also block spawning runs from Kootenay Lake and the Idaho portion of the river from using Boulder Creek in Idaho, the Yaak River, and other major spawning streams.

Katka 1,817 and Rocky Creek 1,868

This two-dam alternative would inundate a total of 19 mi of riverine habitat and would impose two barriers to fish movement. These barriers would affect fisheries as far downstream as Kootenay Lake. Thus, it would have a greater impact than Katka (1,862) by itself.

Rocky Creek 1,857 and Kootenai Falls 1,990

This alternative would inundate 12.3 mi of river, and like the other two-dam alternative, would present two barriers to fish movement.

In comparison, the proposed dam at Kootenai Falls would flood 4.5 mi of the best rainbow trout fishery on the river and reduce movement of trout into the river downstream from the falls. An additional 0.8 mi of habitat would be dewatered (Robinson 1981b).

VEGETATION AND WILDLIFE

Vegetation and wildlife of the alternative project areas is described in Nichols (1981). Coniferous trees dominate vegetation at the sites and species composition is similar to that at Kootenai Falls. The entire Kootenai River is used by ospreys and bald eagles; an important elk winter range is located within the Katka project area. Table 5-3 lists each alternative with its most pertinent vegetation and wildlife concerns. Table 5-2 compares the amounts of various habitats which would be inundated by each alternative. The Katka 1,862 ft reservoir would inundate by far the most vegetation of all the alternatives; the two Kootenai Falls alternatives would inundate the least. However, in terms of habitat and wildlife diversity, the loss of habitat at Kootenai Falls would very likely result in the most dramatic change in wildlife species diversity. This is because several notable habitat types that would be lost if the project were built at Kootenai Falls are not present at the other sites. These include the falls, major rapids, and a rocky canyon, which support species not found at the alternative sites. Figure 4-4 and table 4-2 show species associated with the affected habitats.

TABLE 5-2. TYPES OF LAND COVER INUNDATED BY DAMS AT ALTERNATIVE SITES ON THE KOOTENAI RIVER* (acres)

	Deciduous Trees	Shrubs	Conifers	Grass or Hay	Rock & Gravel Bar	Other	Total
Katka 1,862	141.6	17.2	806.0	118.5	290.0	192.7	1,566.0
Katka 1,817	22.3	0.5	107.7	9.8	83.9	38.1	262.3
Rocky Creek 1,842 **	2.5	5.8	123.0	7.3	98.6	36.7	273.9
Kootenai Falls 1,990	6.4	0.6	1.2	3.1	4.1	1.0	16.4
Kootenai Falls 2,000	10.7	1.3	5.1	3.4	4.4	6.7	31.6

* *Assuming a flow of 25,000 cfs for all but Kootenai Falls 1,990 ft, where a flow of 50,000 cfs is assumed.*

** *No inundation estimates are available for Rocky Creek 1,868 or 1,857*

Source: Nichols, 1982.

TABLE 5-3. WILDLIFE CONCERNS AT ALTERNATIVE SITES

	Wildlife Concern	Habitat Characteristics	Location of Concern	Impacts	Possible Impact-Reduction Measures
1.	Riparian habitat	Cottonwood trees with shrubby understory	All new dam sites	Loss of habitat by inundation, ground-water effects, and construction-related clearing	Lowering reservoir elevations
2.	Bald Eagle	Wintering areas with open water and perch sites within 50 ft of water	Katka Rocky Creek Broadwater	Loss of habitat by inundation of perch trees, construction related displacement, increased probability of freezing over of reservoirs	Maintenance of perch trees, and avoidance of high use areas during winter
3.	Osprey	Nest and perch sites (usually snags near open water)	Katka Rocky Creek Painted Rocks	Loss of perch and nest trees during clearing or as a result of inundation	Maintenance of nest and perch trees along reservoir
4.	White-tailed Deer habitat	Structurally diverse riparian areas	Katka Rocky Creek Broadwater	Loss of habitat by inundation and clearing	Lowering of reservoir elevation
5.	Mule Deer winter range	Windswept areas near timber during winter	Broadwater Painted Rocks	Construction-related displacement during winter	Avoidance of critical areas during winter
6.	Elk winter range	Windswept slopes near timbered draws and low elevation winter range	Katka Broadwater Painted Rocks	Construction-related displacement, inundation of winter range	Avoidance of critical areas during winter, construction of lower dam than suggested at Katka

RECREATION AND AESTHETICS

Katka 1,862

The Katka site lies in a scenic canyon upstream from a tree covered island and downstream from a broad bay at a bend in the river. Access to the site and the lower reaches of the 18-mi long reservoir that would result from the Katka (1,862) project is extremely difficult except by boat from upstream launch sites. There are no public roads to the river from Leonia to Katka, and limited access from Leonia to Troy. Recreation is confined to boating and fishing, with no facilities or developed areas below the mouth of the Yaak. The railroad parallels the river for the entire 18 miles, providing a possible means of access that is seldom-used. There are no formal use-level estimates for this stretch of river, but overall use is probably low.

The main recreation sites along this stretch are the campgrounds on either side of the Yaak at its confluence with the Kootenai. These campgrounds receive moderate use: Wall (1978) estimated that they were visited by 2,445 individuals from July 1 to August 18, 1978. The reservoir would inundate part of the camping areas, requiring new facility development. The only significant stretch of whitewater from Troy to the Moyie River lies directly opposite the campgrounds. More challenging stretches of whitewater would remain elsewhere on the Kootenai.

There would be good access to the Katka reservoir, increasing recreational use levels. The reservoir would remain quite scenic, set against a steep canyon backdrop. Opportunities for solitude would decrease, but are currently somewhat limited by the close proximity of the railroad. Fishing quality would probably decrease, but the effect would not be as pronounced as at areas that currently have high use levels. The Katka (1,862) project, although it would inundate a longer stretch of river, would have fewer adverse and more beneficial effects on recreation than a dam at Kootenai Falls.

Katka 1,817 and Rocky Creek 1,868

The Rocky Creek dam site, approximately 8 mi upstream from Katka, lies in a canyon more constricted than at Katka. The reservoir created by the dam at Rocky Creek would extend upstream past Troy, and the combined pools of the two dams would be longer than the one that would be created by Katka (1,862). Beneficial and adverse impacts would be much the same as those resulting from the Katka (1,862) dam. Access to the reservoir would be easy, resulting in substantial recreation use. The two dam structures would intrude on scenic beauty, however, inundating approximately 2 more mi of river and breaking the reservoir into two segments. HARZA Engineering Co. (1980) reported that the Katka (1,862) project was more favorable than the combined Katka-Rocky Creek project, both economically and environmentally. Considering this, and the slightly greater recreational benefits resulting from the Katka (1,862) dam, from the recreational resource point of view the Katka (1,862) project is preferred over the combined Katka-Rocky Creek project.

Kootenai Falls 1,990 and Rocky Creek 1,857

A lower dam (1,990) at Kootenai Falls would have most of the same major adverse impacts on aesthetics and recreation as the proposed dam. When the impacts of the Rocky Creek (1,857) project are included, the combined effect is more adverse than the Katka (1,862) project.

HISTORY AND ARCHAEOLOGY

Katka 1,862

Twenty prehistoric campsites along the Kootenai River from the mouth of the Yaak River upstream to the vicinity of Troy would be inundated or subjected to higher groundwater and bank erosion if Katka 1,862 were built (Davis, C. 1981; Collins 1981). The portion of the river that would be affected by this alternative and the other alternative dams has not been intensively surveyed for cultural resources, so unknown sites may exist there. The sites currently on record have not been thoroughly evaluated according to National Register criteria, but there are relatively few archaeological sites remaining on the Kootenai River to provide understanding of the Kootenai prehistory, making it likely that all those remaining would be considered significant.

Loss of archaeological data would adversely affect the ability to interpret the prehistory of the area for the public. Impacts to archaeology and to the public could be reduced through excavation, analysis, and interpretation of the sites.

Katka 1,817 and Rocky Creek 1,868

This alternative would inundate the same 20 archaeological sites that would be affected by Katka 1,862, and would cause inundation and high groundwater in Troy. Troy contains 35 historic structures that could be subjected to these effects. The affected structures include public and commercial buildings, residences, a bridge and a church. SHPO is preparing to nominate these sites for inclusion in the National Register as a cultural resource district.

High groundwater could increase decay of the foundations of historic buildings, cause their septic tanks to malfunction, and render them uninhabitable and nonrehabilitable.

Impacts to archaeology could be reduced in the same manner as for Katka 1,862. Troy's historic buildings could be moved to higher ground, but this would have impacts of its own. The buildings would lose the historic association with their surroundings.

Rocky Creek 1,857 and Kootenai Falls 1,990

This alternative would affect 57 known historical and archaeological sites. Thirty-seven of these are in the Kootenai Falls Cultural Resource District, and would also be affected by the proposed project. Twenty of these sites would sustain impacts from construction, inundation, or increased groundwater levels, as discussed in the proposed project impacts section. The 20 sites affected by Katka 1,862 would be similarly affected by this alternative.

KUTENAI INDIAN RELIGION AND CULTURE

The Kutenai Indians have said that the entire Kootenai River is sacred to them, and they oppose any further dams on the river. All of the applicant's alternatives involve impoundment of the Kootenai; none is acceptable to the Indians, and there would be no way of reducing the impacts.

KUTENAI INDIAN SUBSISTENCE

The Kutenai Indians claim their subsistence activities along the entire Kootenai River, including the alternative sites section, are protected by the Hellgate Treaty of 1855. Food gathered by the Kutenai may have as much religious or traditional significance as nutritional value (DeReitzes and Sugameli 1980; Echo-Hawk 1980). All the Kootenai River alternative dams would affect subsistence resources and none would be acceptable to the Kutenai.

SOCIAL AND ECONOMIC CONCERNS

The social and economic impacts of the alternatives would not vary greatly from those described for the dam at Kootenai Falls. All alternatives would create economic and social activity surrounding construction for a few years followed by the presence of a very small operating workforce. The only favorable long-term impact of much importance would be the property taxes paid to local governments, particularly the school district in which the facility is built.

The cost of the Katka and Rocky Creek projects would be higher than for Kootenai Falls. Table 5-4 compares the construction costs and the tax revenues that would result from each of the alternatives. For the Katka 1,817/Rocky Creek 1,868 alternative, tax benefits would accrue to the McCormick elementary school district and the Troy high school district. For Rocky Creek 1,857/Kootenai Falls 1,990, the McCormick elementary, Troy elementary and Troy high school districts would all receive tax benefits.

Precise work force data are not available for the Katka and Rocky Creek alternatives because engineering designs are not detailed enough to provide them. Estimates were based on the construction schedule and the proportion of payroll to construction costs for the Kootenai Falls project. In the case of Katka 1,862, the peak work force would be 820; for Katka 1,817/Rocky Creek 1,868, 1,020; for Rocky Creek 1,857/Kootenai Falls 1,990, 840; based on a peak work force of 500 at Kootenai Falls.

The social and economic impacts associated with work force influxes and population increases would therefore be greater with any of the three alternatives than with the proposed dam at Kootenai Falls.

In spite of the larger population influx associated with each of the alternatives, the social and economic effects would still be less than the "boom" conditions experienced during Libby Dam construction. Either Katka 1,862 or Katka 1,817 Rocky Creek 1,868 would avoid the long-term detrimental impact to the quality of life in Lincoln County that would result from loss of Kootenai Falls in its current form as an aesthetic and recreational resource.

TABLE 5-4. ESTIMATED TAX REVENUES OF WMED'S ALTERNATIVES (1981 Dollars)

Jurisdiction	Proposed dam at Kootenai Falls	Katka 1,862	Katka, 1,817 Rocky Creek 1,868	Rocky Creek 1,857/ Kootenai Falls, 1,990
Boundary Co., Idaho:				
Total	-0-	$3,107,134	$2,274,450	-0-
Lincoln Co., Montana:				
Total	$1,694,208	-0-	$1,158,940	$2,787,387
County Gov't.	170,531		158,907	319,357
County-wide schools	453,354		442,443	849,009
Troy schools	1,003,033		319,615*	1,375,674*
McCormick schools			203,257*	173,513*
State	37,290		34,747	69,834

** The Rocky Creek dam would be in the McCormick elementary school district and Troy high school district contributing tax revenues to both.*

DNRC's CONVENTIONAL ALTERNATIVES

RETROFITS OF EXISTING DAMS

DNRC reviewed approximately 660 existing dams and diversions in Montana to determine their potential for hydroelectric retrofit. This review found that among the numerous dams in or near the WMED service area that have potential for power production, only three have been investigated sufficiently to allow analysis of costs, impacts, and benefits of development. These three are Painted Rocks, Clark Canyon, and Broadwater. The capacity and cost of these dams is shown in table 5-5.

TABLE 5-5. EXAMPLES OF POWER PRODUCTION AND COSTS OF DAM RETROFITS

Existing Dam	Installed Capacity (MW)	Annual generation (million kWh)	Construction cost (1981 dollars)	1st year cost (mills /kWh)	Levelized cost mills/kWh)
Painted Rocks	5.2	16.1	$ 4.6 million	41.96	18.25
Clark Canyon	3.46	17.8	$ 2.27 million	18.91	8.26
Broadwater	9.76	56.44	$14.7 million	36.04	14.53

Part of the Public Utility Regulation Policy Act (PURPA 1978) requires utilities to buy energy from small power producers at avoided costs. This led to great interest in developing small projects, and many applications have been filed to FERC for preliminary evaluation.

Energy generated by retrofitted dams would be available to WMED if it were to lease the dams and build the retrofits itself, or through purchase of the power from other developers. Arrangements for construction or purchase of power would have to be negotiated between WMED and the dam owner or license holder. These negotiations could be protracted and complicated, but the construction period of the retrofits would be much shorter than for the Kootenai Falls dam, so power from the retrofits might come on-line at about the same time as power from Kootenai Falls. State legislation gives preference to public utilities and electric cooperatives to develop state owned dam and water projects for hydropower purposes (SB229 April 23, 1981).

Painted Rocks Dam

This dam is located on the West Fork of the Bitterroot River and owned by the State of Montana. DNRC and the City of Billings have filed competing preliminary permit applications to FERC to install generators.

Clark Canyon Dam

This dam is owned by the Bureau of Reclamation. WMED filed the first application for a preliminary permit (FERC project No. 3530). Several competing applications were filed subsequently with the City of Kalispell the successful applicant.

Broadwater Dam

This dam on the Missouri River near Toston is owned by the State of Montana and has been studied for development by the Water Resources Division of DNRC. A preliminary FERC permit has been granted and an application for a license is being completed.

IMPACTS OF DAM RETROFITS

Geology

Turning existing water control dams into power generation facilities has little or no effect upon geologic processes unless the pattern of water release or reservoir level is changed. Altered flow patterns in the stream below the dams could affect sediment transport, thus inducing changes in the morphology of the channel and other characteristics of the stream. However, if the timing and quantities of releases remain the same after the modification, the effect of the dam on the river will not be altered. Similarly, if reservoir level (or management of that level) is not changed, the effect of the generation facilities would have no significant effect.

Fisheries

For this analysis it was assumed that operation of hydroelectric facilities at these dams would not affect flow regimes nor change the point of discharge from the reservoirs. Under existing proposals, reservoir elevations would not change at Painted Rocks and Clark Canyon Dams, and would increase only 1.6 ft at Broadwater Dam.

There would be potential fishery impacts at all the retrofits from mortality of fish passing through turbines. The mortality rate of fish passing through turbines depends on the size of the fish and the design and operating characteristics of the turbines. Information on these factors is lacking for the retrofits, so no predictions can be made regarding fish mortality.

It is anticipated that there would be short-term sedimentation impacts from construction at all of the projects. Overall, however, it appears that impacts of these three projects would be of much less magnitude than those of the Kootenai Falls dam, providing suitable care was taken during construction. The primary concerns of each project are as follows.

Painted Rocks Dam. The West Fork Bitterroot River below Painted Rocks Lake provides a good trout and whitefish fishery and is ranked as a Class II (high priority) fishery. Stocked rainbow predominate in the lake. In the past it has been necessary to stock rainbow in the river to maintain the sport fishery (DNRC 1976).

The river fishery has suffered because of dewatering and the lake fishery has been adversely affected by drawdowns during inspections and repairs, and these may be the major fishery limitations. There are no detailed construction plans for the retrofit, but it appears that dewaterings and drawdowns could occur again as part of the retrofitting process.

Clark Canyon Dam. Fisheries were studied in more detail for this retrofit than for the others. The information in this discussion came from Nelson, 1977. The fishery is characterized by large numbers of trophy-sized (up to 5 lbs) trout and is ranked as Class I ("Blue Ribbon") fishery. The sport fishery in the reservoir depends upon the planting of hatchery rainbow trout, which grow well there.

Nelson's study (1977) of the effects of flow releases from Clark Canyon Reservoir has some important findings that would be relevant to this project during construction and possibly during operation. It was found that the survival of 3-year and older rainbow trout in the river downstream from the dam is directly related to the magnitude of flows during the nonirrigation season (mid-October through mid-April). It appears that one average daily flow of less than 150 cfs is sufficient to reduce survival of older rainbow trout. Average daily flows greater than approximately 250 cfs are needed to provide a high quality, trophy rainbow trout fishery.

The reproduction of brown trout appears to be related to flow patterns during the brown trout spawning period. Nelson's study showed that the most young brown trout were produced when there were no drastic flow fluctuations, with flows gradually decreasing to a minimum of 150 cfs during the mid-September through late October spawning season.

Flows also influenced the reproductive success of rainbow trout. The most young rainbow trout were produced when flows without large or violent fluctuations increased from 200 cfs to about 700 cfs between early March and late April. Poor reproduction success was a major limitation on total fish numbers and biomass in Nelson's study. Based on these results, Nelson concluded as follows regarding flows from Clark Canyon:

1) Violent fluctuations in flow release at Clark Canyon dam should be avoided during the rainbow and brown trout spawning periods. Flow releases decreasing and then increasing by 125 cfs within a two week period are undesirable.

2) A minimum flow release of approximately 200 cfs is needed at Clark Canyon Dam to provide a high quality, trophy rainbow trout fishery in the upper Beaverhead River.

Any retrofit project could include consideration of maintaining flows for optimum trout survival and reproduction.

Broadwater Dam. The section of the Missouri between Broadwater Dam and Canyon Ferry Reservoir is a nationally acclaimed recreational trout fishery and is valued as a Class I (Blue Ribbon) fishery. The fishing here is exceptional during the fall when brown trout migrate from Canyon Ferry Reservoir and up the river on their annual spawning run. Many of these fish are in the 5 to 10 lb class. These migrants congregate below the impassable structure of Broadwater Dam, creating a localized, heavily used trout fishery.

It appears that few environmental impacts would result from adding generating facilities at this dam. A fish ladder has been suggested as a possibility for this facility but there is no definite plan regarding such a facility, pending further study (DNRC 1980a).

Recreation and Aesthetics

Painted Rocks Dam. The 32,362 acre-foot reservoir is surrounded by steep, partially-wooded hillsides sloping sharply to the water's edge. A good quality unpaved road stretches along the east shore of the reservoir. The area is largely natural in appearance with modifications limited to a dam and spillway, boat ramps and docks on the shore, and a few vacation homes. Fishing, swimming, motorized water sports, and trailer camping are popular summer activities, with ice fishing on the reservoir in winter. The U.S. Forest Service maintains one campground and two boating sites along the reservoir. The combined use level estimate for the three sites is 5,500 visits per year (Troxel 1981). The river below the dam is rated as a Class II fishery and fishing is an important use. If fishing quality were not impaired, the recreation and aesthetic impacts of adding generators would be small.

Clark Canyon Dam. The Bureau of Reclamation maintains eight campgrounds of varying sizes: seven on the reservoir and one on the Beaverhead River immediately below the dam. There is also a small day use area on an island in the north end of the reservoir. There is ready access to the water, and boats can be launched manually on approximately 70 percent of the shoreline (Morehouse 1981). Morehouse estimated use levels for 1980 at 30,786 visitor days, with visitors remaining an average of four days. Fishing is the most important recreation activity, and DFWP plants 250,000 fish in the reservoir annually. DFWP (1980) rates the Beaverhead from the dam to Grasshopper Creek as a "Blue Ribbon" fishery, and many outfitters lead boat trips starting below the dam.

Adding generators to the Clark Canyon dam would have few impacts on recreation if care is taken to maintain fishing quality.

Broadwater Dam. The banks of the reservoir are almost entirely undeveloped. Access to the area is provided by a good quality unpaved road from Highway 287 and from several downstream boat launching sites maintained by DFWP. The river upstream from the dam flows through a scenic canyon with several inviting islands and historical sites. There is a small and poorly-maintained recreation area at the left abutment of the dam, and a walkway across the dam provides access to the opposite bank. The Bureau of Land Management maintains a primitive recreation site less than a mile downstream from the dam. The most popular recreation activity is fishing. The Montana Department of Fish and Game (1975) reported that fishing pressure during the summer of 1975 on the river from the dam to Canyon Ferry was 4,619 man-days, indicating moderate use levels compared to that upstream from the falls on the Kootenai. DNRC plans for developing the site would include replacing recreational facilities lost by adding generators to the dam. Impacts to recreation and aesthetics would be small, provided that fishing downstream from the dam did not decline in quality.

Vegetation and Wildlife

None of the dam retrofits reviewed by DNRC would affect wildlife beyond the construction period. No endangered or critically important wildlife or plant communities are known to exist near these sites.

Impact reduction at these projects probably would be most concerned with impacts during construction, because the dams and reservoirs are already in place (table 5-3). Changes in flow caused as a result of generation regimes would have to be evaluated on an individual basis prior to determination of impacts and efforts to reduce them.
them.

Archaeology and History

Painted Rocks Dam. DNRC conducted a literature review and searched SHPO's survey data file but found no sites recorded. Before any construction were to be approved, the area could be surveyed to identify and record any cultural resources that might be affected. If any sites were identified on the construction area, impact reduction plans could be developed in consultation with SHPO.

Clark Canyon Dam. The existing dam inundated the historic town of Armstead and Camp Fortunate of the Lewis and Clark expedition, where the explorers camped in August, 1805. At least three archaeological sites are located above the normal high water mark.

DNRC's search of SHPO files did not indicate the presence of any sites that might be affected by generator installation at Clark Canyon Dam, providing the reservoir level is not increased. Before the approval of any proposed project, there could be a cultural resource survey of the area, and SHPO could be consulted in the development of any plans to reduce impacts.

Broadwater Dam. The west bank of the Broadwater Reservoir has a prehistoric campsite that was occupied periodically from the early Middle Prehistoric Period to the Late Prehistoric Period (Davis and Bell 1980). In December, 1980, DNRC submitted documentation on the site to FERC and the SHPO to determine whether the site was eligible for listing on the National Register of Historic Places. SHPO believes the site is eligible, but FERC has not yet acted.

The increase in reservoir elevation that would result from the project would adversely affect the prehistoric campsite. If the project were to be approved, plans to reduce impacts could be developed in consultation with SHPO.

Social and Economic Concerns

Painted Rocks/Clark Canyon. The Painted Rocks project near Darby and the Clark Canyon project near Dillon would be comparable in scale to the Broadwater project. The potential for local hiring and surplus housing is greater in Dillon (1980 population 3,976) than in Townsend (population 1,587), especially considering the current high unemployment in the Butte-Anaconda area 60 mi north. Darby is small (1980 population 580), but it is only 65 mi from Missoula. The current decline in the lumber industry has produced a surplus labor pool in the Missoula area from which the manpower requirement for the Painted Rocks project could be drawn. For both projects, commuting from the larger urban areas is more feasible than living in mobile homes or trailers in the nearest small town for the expected construction period of six months to two years.

Broadwater Dam. Estimates prepared by DNRC indicate construction would require a maximum of 30 workers for a peak construction period of 6 months. Construction would take 18 months. If all 30 workers with an average family size of 2.28 people moved into Broadwater County, as was predicted for the Kootenai Falls project, the influx would amount to two percent of the county population. Most of these people probably would settle in Townsend, approximately 20 mi from the dam. There is no surplus housing in the nearby communities of Toston and Radersburg, though trailers and mobile homes could be accommodated.

If there were a policy of local hiring, the population influx would be very small. If workers with specialized skills had to be recruited outside the immediate area, enough could be found in Helena and Bozeman, within commuting distance of the project site.

The small, temporary population increase expected for the Broadwater project would not noticeably increase the demand for schools and public services. Income effects would be small and the impact of increased income on businesses would depend on where workers lived. Long-term tax benefits would also be slight.

COAL-FIRED GENERATION

The FERC impact statement included an examination of a coal-fired alternative. As with the other FERC alternatives, it was sized to give the same dependable capacity as the Kootenai Falls project (144 MW). To achieve this capacity, FERC sized the plant at 173 MW, implying a 17 percent forced outage rate. The hypothetical plant was run to produce the same energy as the Kootenai Falls project, 515 million kWh, with a credit of 8.1 mills/kWh for excess generation beyond that level. The excess generation would be sold to other utilities with the revenues from the sale used to offset the cost of energy to the WMED customers. The 173 MW plant was assumed to run at 70 percent capacity, producing 1.06 billion kWh per year. The credit for excess generation amounts to $4.4 million. DNRC considered this approach inadequate, because of the unrealistic assumption that generation in excess of that produced by the proposed dam would be sold cheaply, and because costs of the generic coal plant were not given in a way that permitted easy changes in the assumptions. Therefore, it was decided to do a separate evaluation of the cost of energy from a coal-fired plant. Rather than estimate costs for a generic plant of the same capacity as the Kootenai Falls project, it was thought that a specific plant open to regional participation should be used in considering the coal-fired option. In 1976, when approving the application for Colstrip 3 and 4, the Montana Board of Natural Resources and Conservation required that shares be offered to all Montana cooperatives. Direct offers were made to four members of WMED (Ravalli, Missoula, Lincoln and Flathead electric cooperatives). The offers were not accepted. The owners of Colstrip assert that the permit condition was satisfied by these offers. At the time of this writing the Board has not determined whether the condition has been satisfied.

Central Montana Generation and Transmission and the Upper Missouri Generation and Transmission group in turn asked Basin Electric Cooperative, with which they already have all additional requirements contracts and which has extensive experience constructing and operating coal-fired generating plants, to take over their combined 7 percent share of the Colstrip 3 and 4 output. In late 1981 Basin announced it could not reach an agreement with the Colstrip partners over transmission costs and delivery arrangements. DNRC examined the cost of energy for this 98 MW share of the two units.

The two 700 MW units are scheduled to come on line in 1985. Based on 1980 cost estimates filed under PURPA section 133 (Montana Power Co. 1980), DNRC estimates that the on-line capital cost, assuming financing by the electric cooperatives, would be $1,112 per kW in 1981 dollars including interest during construction, or $109.0 million for the 98 MW share.

DNRC estimated the cost of energy from Colstrip under a variety of assumptions about taxes, fuel cost escalation rates, interim replacement costs, and powerline costs. These assumptions result in an estimate of the levelized cost of energy of 25.69 mills/kWh in 1981 dollars. This assumes that the real cost of coal ($9.98 per ton in 1980) escalates at 1 percent per year from an initial cost of 7.13 mills/kWh; that the property taxes are 7 percent of Montana Power Company's estimate of $10.7 million per year; and that a 7 percent share of the twin circuit 500 kV power line from Colstrip to Townsend at a cost of $28.8 million in 1981 dollars, would be an integral part of the share of the plant. Wheeling charges from Townsend to the WMED service area would be additional. First year (1985) costs, consistent with the 25.69 mill/kWh levelized costs, are estimated at 40.70 mills/kWh. The 98 MW share would produce an estimated 644 million kWh with a 75 percent capacity factor.

Purchase of a share of the Colstrip output would not produce any environmental impacts at the site, beyond those already occurring from construction of the Colstrip facilities.

The other coal-fired projects possibly open to outside participation are the Creston plant, 2,000 MW planned for construction in eastern Washington by the Washington Water Power Co. of Spokane, and the Salem Project, a 350 MW plant under consideration by the Montana Power Company for a site near Great Falls. A portion of this proposed plant may be available to WMED, but no cost information was available when this analysis was prepared. Relatively complete cost information is available for the Creston plant. In fall 1981, regional utilities had signed option agreements for 75 percent of the first 1,000 MW.

The Creston proposal was scheduled to bring four 500 MW units on line in 1988, 1989, 1991 and 1992. As of May, 1982, the schedule had slipped to January 1989 and July 1990 for units 1 and 2, with units 3 and 4 unscheduled. State permits were expected to issue by late summer of 1982. Some facilities would be shared by two or more units, so the capital costs are different for each of the units, with the first unit the most expensive. The on-line capital costs, including interest during construction, are projected by DNRC to be $1.43 billion (1988 dollars) for unit 1, $678.2 million for unit 2 (1989 dollars), $1.176 billion for unit 3 (1991 dollars) and $818.6 million for unit 4 (1992 dollars) (Nordell 1982b, costs from Vogt 1981b). In 1981 dollars, the four units are estimated to cost

$722 million, $311 million, $443 million, and $280 million respectively. Costs of fuel, transportation, operation, and maintenance were derived from analyses performed by Seattle City Light. Coal was estimated to cost $8.55/ton in 1980 ($9.67 per ton in 1981), escalating at 1 percent per year in real terms; coal transportation was estimated at $14 a ton in 1980, escalating at 3 percent in real terms until 1990, then 1 percent thereafter.

The estimated cost of energy from the four units is presented below.

ENERGY COST FROM CRESTON COAL PLANTS

1981 mills/kWh

	First Year Cost	Levelized Cost
Unit 1 (1988)	62.4	46.9
Unit 2 (1989)	41.3	36.0
Unit 3 (1991)	48.1	39.5
Unit 4 (1992)	39.7	35.2

The average levelized cost of energy is 39.4 mills/kWh in 1981 dollars.

For a discussion of the environmental impacts of the Creston plant see the draft EIS prepared by the Bureau of Reclamation and the Washington State Energy Facility Siting Evaluation Council (USDI 1981). Purchase of a share in the Creston plant would not cause additional environmental impacts.

NUCLEAR GENERATION

The cost of energy from a nuclear generating plant was examined. The only nuclear plants from which energy appeared to be available to the applicant at the time DNRC conducted its analysis were the WPPSS units 4 and 5 with a combined capacity of 2,490 MW. These units were most recently planned for operation in 1989. Five members of WMED have subscribed to shares in the two units totaling 29.8 MW. WWPPS units 3 and 4 have been terminated, with the loss to the participating WMED members of the 29.8 MW of capacity and about 157 million kWh annually of energy. Further, WWPPS unit 1 has been delayed for up to 5 years. Nevertheless, the cost estimates are presented to indicate the likely cost of nuclear electricity compared with electricity from the proposed dam. For an estimate of the costs to the WMED members of the portion already completed of WWPPS units 4 and 5, see Supply Demand Integration in chapter six.

DNRC estimated the cost of energy from WPPSS 4 and 5. The total investment cost including interest during construction is estimated at $12 billion in 1989 dollars. Figures for fuel and operation and maintenance expenses were obtained from WPPSS; estimates of taxes, insurance and replacements were assumed to be the same percentage of capital costs as those for the Kootenai Falls project (almost certainly understating these costs). All costs except for bond amortization were assumed to be constant in real (inflation free) dollars.

DNRC assumed that the plants would be available 60 percent of the time (Komanoff 1978), giving an annual production of 13.1 billion kWh. The resulting first year energy cost is 91.3 mills/kWh in 1981 dollars, and the levelized energy cost is 55.5 mills/kWh, in 1981 dollars. Nuclear power was eliminated from further consideration as an alternative because of cost.

WOOD-FIRED GENERATION

The FERC EIS considered wood-fired generation as an alternative. As with almost all other alternatives, FERC limited its analyses to a plant or combination of plants of capacity similar to the Kootenai Falls project, and which would be operated to produce the same amount of energy. FERC based its analysis on a study done for the Burlington (Vermont) Electric Department, for three 50 MW units and one 25 MW unit. The cost of acquiring and collecting wood fuel in western Montana would be different than in Vermont. The FERC analysis did not provide sufficient cost information to allow reconstruction of energy cost estimates that could be compared to those of DNRC for the proposed dam.

DNRC examined several other studies done by Rocket Research (Thorn et al. 1980) and BPA and the USFS (Kierulff and Adams 1980). Figures developed in these studies were used to estimate costs for a 25 MW wood fired plant using a costing method and assumptions about taxes and other costs parallel to those used for the Kootenai Falls project. The plant would have a capital cost, including interest during construction, of $72.81 million in 1988 dollars ($36.77 million in 1981 dollars). Fuel costs were developed from two sets of assumptions. The favorable set of assumptions, which resulted in lower cost estimates, assumed an overall plant efficiency of 23.23 percent and an 85 percent capacity factor, for an estimated annual output of 186.15 million kWh. The unfavorable assumptions, which resulted in higher costs, were that overall plant efficiency was 20 percent and the annual capacity was 75 percent, for an estimated output of 164.25 million kWh.

Under the favorable assumptions, the cost of energy from this alternative would be 44.62 mills/kWh during the first year, and 29.36 mills/kWh levelized over a 35 year plant life, in 1981 dollars. Under the unfavorable assumptions the figures are 51.59 mills/kWh and 34.12 mills/kWh, respectively.

ALTERNATIVE DESIGN AND OPERATION OF KOOTENAI FALLS DAM

Besides evaluating the applicant's alternatives and other possibilities of generating and conserving electricity, DNRC considered an alternative design and operation mode for the proposed action. The alternatives are greater release of water over the falls, and a decreased dam and reservoir height. DNRC recalculated the effect of the proposed 1984 Canal Flats diversion to determine the amount of water available for power generation. It is uncertain whether the 1984 diversion will occur, so DNRC also calculated the effects of these alternatives without the diversion (table 5-6).

TABLE 5-6. ALTERNATIVE DESIGN AND OPERATION MODES FOR KOOTENAI FALLS DAM (1931-1968 Hydrologic Data Base)

With Canal Flats 1984 Diversion

Dam Elevation	Minimum Release (cfs)	River Flow Required (cfs)	Average*** Output (Million kWh)	Levelized Busbar Cost (1981 mills/-kWh)
With Canal Flats 1984 Diversion				
2,000*	750	2,250	528	21.20
2,000	1,000	2,500	512	21.86
2,000	2,000	3,500	448	24.98
2,000	4,000	5,500	314	35.64
1,990**	750	2,250	474	22.95
1,990	1,000	2,500	461	23.60
1,990	2,000	3,500	402	27.06
1,990	4,000	5,500	282	38.58
Without Canal Flats Diversion				
2,000*	750	2,250	666	16.80
2,000	1,000	2,500	651	17.19
2,000	2,000	3,500	590	18.97
2,000	4,000	5,500	466	24.02
1,990**	750	2,250	596	18.25
1,990	1,000	2,500	587	18.53
1,990	2,000	3,500	528	20.60
1,990	4,000	5,500	418	26.03

* *Applicant's proposed dam height and flow release.*

** *Kootenai Falls dam proposed in Applicant's Alternative III.*

*** *DNRC estimated energy at 85 percent turbine efficiency (Rubich and Karp 1981)*

The proposed dam at Kootenai Falls would be more cost-effective than most other conventional facilities (see table 5-7). The only known facilities that could produce electricity cheaper than the proposed dam are three small-hydro retrofits producing a total of 10.3 average MW.

TABLE 5-7. LEVELIZED COST OF ENERGY FROM THE PROPOSED PROJECT AND ALTERNATIVES

	Cost (mills/kWh)
Proposed Kootenai Falls Project	21.6
Applicant's Alternative I (Katka 1,862)	32.6
Applicant's Alternative II (Katka 1,817-Rocky Creek 1,868)	40.51
Applicant's Alternative III (Rocky Creek 1,857-Kootenai Falls 1,990)	26.73
Broadwater Dam Retrofit	14.5
Painted Rocks Dam Retrofit	18.3
Clark Canyon Dam Retrofit	8.3
Creston	39.4
WPPSS 4 & 5	55.5
Wood-fired generating plant	
Favorable assumptions	29.4
Unfavorable assumptions	34.1
Colstrip 3 & 4	25.7

DNRC ENERGY CONSERVATION ALTERNATIVES

DNRC reviewed various means of increasing the energy efficiency of customers in the residential, commercial, industrial, and irrigation sectors. Conservation saves energy at the actual location of the customer, so no delivery costs are associated with it; accordingly, the cost-effectiveness of a conservation measure is determined by comparison with the delivered cost of electricity from the proposed dam at Kootenai Falls. The delivered cost includes the cost of new transmission and distribution lines to carry the additional power from the dam. The costs of supplying electricity varies between the different customer classes; therefore, each customer class is faced with a different delivered cost of electricity from the proposed dam.

RESIDENTIAL CONSERVATION

DNRC examined two types of improvements in energy efficiency in houses: conservation retrofits to existing houses, and the inclusion of energy efficiency features in the construction of new homes. Homeowners rather than the applicant probably would have to pay the property taxes on conservation measures, so taxable values were assumed to be 8.5 percent of cost, compared with 3 percent of cost for Rural Electric Cooperative generating facilities.

Conservation Retrofits of Existing Dwellings

DNRC analyzed the potential for conservation in existing one story, two story and mobile home residences in the WMED service area. This analysis covered the conservation potential only for residences that now use electricity as their primary heating source. DNRC did not have enough information to analyze the conservation potential of lighting or any residential appliance use except for hot water heating. It was found that there was a potential saving of 3.4 average MW.

Conservation in Mobile Homes

DNRC gave special attention to mobile homes because on the average they are not as well insulated as standard houses, and because the literature (Wiedl and Corbett 1977; Tietsma and Peavy 1978; Cormier 1981) indicated great potential for energy savings. However, all the methods of retrofitting mobile homes have drawbacks that would reduce the acceptability or marketability of the homes.

The only measure that appears cost-effective, given the relatively short life expectancy of mobile home retrofits (mobile homes have an expected life of 18 to 22 years) is the installation of storm windows on single glazed windows. This results in an average saving of 336 kWh per year per mobile home at a cost of $35, for a levelized energy cost of 11.74 mills.

Water Heater Wraps

DNRC estimated the potential for saving energy by adding insulating jackets to electric water heaters. Estimated savings are 3.75 million kWh, or .429 average MW.

Implementation of Residential Conservation

In order to receive the benefits that would result from installing conservation measures in existing housing, WMED could finance all the measures described and then add a billing rider, based on the estimated energy saved, times the cost net of the subsidy. DNRC estimates that, levelized over the life of the conservation measure, a single family home receiving the full conservation treatment would have a rider on its bill for 364.4 kWh per month, at a net charge of 2.97 mills, or $1.08 per month. The two story home would have a conservation rider for 361.8 kWh per month, at a charge of 1.45 mills/kWh, or $.52 per month. The mobile home would have a rider for 240.1 kWh annually, or 20 kWh per month, at a charge of 8.81 mills per kWh, or $.18 per month (Nordell 1982a). In the case of water heater wraps, it would probably be sufficient for the applicant to install them at no cost to the customer. (The actual riders would be in nominal dollars, spread out over the life of the measures.)

Summary of Residential Conservation Benefits from Existing Homes

Commercially available residential conservation retrofit measures, such as insulation, storm windows, weatherstripping, and caulking save energy at a much lower cost than that of electricity from the proposed dam. Installation of such measures could save an estimated 3.8 average MW.

Adverse Impacts of Residential Conservation

The major significant impact that might result from measures to improve the thermal integrity of houses is the impact on the quality of indoor air. As uncontrolled infiltration is reduced, pollutant levels may rise in the air inside the house. Suspected pollutants include particulates, fluorocarbons, formaldehyde, and radon. If resulting levels of pollution present significant health hazards, it may be necessary to install heat exchangers for controlled ventilation, at a cost of $750 per house (see Energy Efficient New Homes, below).

Recent experiments at the Midway Substation by Bonneville Power Administration, with careful monitoring of pollutant levels before and after tightening indicate that in most cases the increase in concentrations of air pollutants does not raise them above levels that have generally been accepted as safe (Offerman et al. 1981).

Conservation from Building Energy-Efficient New Homes

The demand for electricity in the WMED service area is expected to increase as new residents enter the area and new homes are built. The size of this increase could be reduced by building the houses to high standards of energy efficiency. DNRC examined a variety of commercially available building techniques and materials that could be incorporated in the construction of new homes to determine if they could be cost-effective in reducing the future demand for electricity.

Most recently-built houses in the WMED service area use wood for supplemental or primary heating. Wood meets approximately 60 percent of the combined heating load (exclusive of that met by energy gained from the sun, the occupants, and appliance use) of all recently-built single family houses, with electricity accounting for nearly all the remaining 40 percent. Other fuels are little used in heating this category of houses in the WMED service area (Cartwright 1982b). Therefore, only 40 percent of the energy that would be saved by building energy-efficient housing would be electricity that could be considered as an alternative to the power that would be produced at Kootenai Falls. At that level of savings, purchase of the improved measures would not be cost-effective for the applicant, nor could the applicant offer any substantial subsidy to homebuyers to purchase them on their own (Cartwright 1982b).

COMMERCIAL SECTOR CONSERVATION

The commercial sector in WMED's service area contains a great diversity of business types, with a wide range of commercial and light industrial processes (e.g., cooking, dry cleaning, sheet metal forming, lumber milling) According to the WMED's commercial survey (WAI 1981b), the largest groups are agricultural services (around 10 percent), lumber and wood products (6 percent), eating and drinking places (9 percent), "other retail trades" (13 percent), miscellaneous services (12 percent), hotels and motels (8 percent) and schools and public buildings (7 percent).

Measures investigated included the installation of insulating jackets on water heaters and insulating wrap on hot water pipes, efficiency improvements and improved controls on heating, ventilating and air conditioning systems, installation of more efficient lighting, tighter control over lighting levels in buildings and in outside lights, and a variety of measures to reduce electricity use in motors.

DNRC concluded from its analysis that there are likely to be substantial cost effective savings in the commercial sector, but the lack of data prevents estimation of their magnitude.

INDUSTRIAL CONSERVATION

The analysis of industrial conservation focuses on the lumber industry, the only one for which adequate information was available. This industry had an average load of 6.1 MW in 1979, more than half WMED's entire industrial load.

Other industrial loads in the service area include a pipeline gas compressor, four secondary oil recovery projects, a small oil refinery, and railroad tunnel ventilation fans. These loads totaled an average of 3.3 MW in 1979, but their potential for energy conservation could not be analyzed without research beyond the scope of this EIS.

This analysis (Cartwright 1981d) covers 16 relatively small lumber and wood products companies, which consumed 53,134,350 kWh—roughly 5 percent of WMED's load—in 1979, and between half and two thirds of WMED's entire industrial load. None of the largest wood products mills in western Montana is served by WMED.

Approximately 74 percent of the electricity used by the mills drove electric motors, with the remainder going for plant heating and cooling, and other uses (DOE 1981).

Five conservation options were examined to determine their cost-effectiveness: conversion from hydraulic to friction debarking, installation of electric motor power factor controls (which increase the efficiency of lightly loaded motors), installation of high efficiency lights, increased sander and saw maintenance, and the production of electricity by burning wood wastes to produce steam for process use and power generation (cogeneration).

DNRC's analysis indicated there was only 0.15 MW of conservation potential in the portion of the Montana lumber industry served by WMED. Given this limited conservation potential and the economic fluctuations of the lumber industry, conservation in the lumber industry does not appear to be an alternative to the proposed dam at Kootenai Falls.

IRRIGATION CONSERVATION

During the period 1977-1979, the irrigation sector accounted for 9.2 percent of the WMED load. In 1979, irrigation drew 87,543,000 kWh (10.0 average MW), 8.5 percent of WMED's total load. Based on limited data, most of the systems served by WMED appear to be sprinklers, many of which are center pivot installations. Flood irrigation is still used extensively, but many such systems have been converted to sprinklers in recent years. In 1979, WMED provided power to approximately 2,300 pumps with a median horsepower of 28.3.

Several conservation options are appropriate for irrigators in the WMED service area (Cartwright 1982e). Improved pump maintenance, accompanied by a program of pump testing to identify where this option would be applicable, is a proven option. BPA, in a regional pilot program, found that three-fourths of all pumps tested were operating below recommended efficiency levels. On a northwest regional basis, BPA estimates that an 18 percent reduction in electricity use for irrigation is possible with the use of commercially available technology; however, only a 12 percent savings is economically feasible at present, which would be 1.2 MW for irrigators in the WMED service area, if the BPA estimate of potential saving is applicable.

RENEWABLE ENERGY ALTERNATIVES

Renewable energy installations are relatively small in size and output in comparison to conventional energy facilities, often are located at the point of energy use, and convert renewable energy resources—solar energy, wind, falling water, biomass (such as wood, straw, manure, garbage), and geothermal heat—into usable forms of energy. DNRC reviewed the commercially available renewable energy technologies to determine whether they were cost-effective as alternatives to the proposed dam at Kootenai Falls.

Heat Pumps

Unlike conventional heating systems, heat pumps do not convert fuel to heat but merely move heat from one location to another. DNRC analyzed the feasibility of heat pumps for a variety of conditions in the WMED service area.

It was found that although heat pumps can be cost-effective in the average all-electric house without wood backup and for appropriately located mobile homes, they would not be cost-effective for the average home once less costly conservation measures have been installed. Heat pumps would not be a cost-effective alternative in the average well-insulated houses to be built in the future (Cartwright 1982a).

Solar Domestic Hot Water

Solar domestic hot water (SDHW) systems meet some portion of a home's requirement for hot water by using the sun to heat the water. The amount of energy that can be provided by a given SDHW system depends on a number of variables: size and type of system, water inlet temperature, desired temperature of hot water, amount of hot water used each day, amount of sunlight available, and outdoor temperature.

DNRC based its analysis (Cartwright 1982f) on the simulated performance of a typical 2-panel active SDHW system with 46.6 sq ft of collection area. A growth in conservation consciousness, or at least cutbacks in response to increased costs of water and energy, is likely over the next few years, so future average use was estimated to be 12.5 gal/person/day, at an outlet temperature of 110 degrees F, somewhat below current use levels. The annual average output of a SDHW system incorporating the assumptions above would be equivalent to 1,939 kWh.

To permit a test of the sensitivity of the economic analysis to different choices of values for the size of collector area and the amount of water used per person per day, DNRC also calculated the output for an average two panel system providing 20 gal/person/day and for an average three panel system providing 20 gal/person/day. These calculations showed outputs of 2,557 kWh for the first situation and 3,080 kWh for the second.

The most economical SDHW system for WMED would be an installation on a new house in Dillon, the sunniest location in its service area. The levelized cost for an average system at various use loads and number of panels in the Dillon area is presented in table 5-8.

TABLE 5-8. COST OF ENERGY FROM NEW SOLAR DOMESTIC HOT WATER SYSTEMS

Type of System	Cost*
2 panel, 12.5 gal/person/day	97.8 mills/kWh
2 panel, 20 gal/person/day	74.2 mills/kWh
3 panel, 20 gal/person/day	95.4 mills/kWh
Kootenai Falls dam (delivered price)	31.4 mills/kWh

** Costs for occasional replacement of antifreeze, pipe insulation, caulking, and glass are included. Tax benefits available to the resident are not included.*

Thus, SDHW systems are not economically competitive with electricity from the proposed Kootenai Falls dam, even in the most promising region of the WMED service area and with a usage rate and panel size greater than that used by DNRC. The cost of a new 2 panel system (12.5 gal/person/day case) would have to drop by almost two-thirds to about $890 ($19.10/sq ft), and the cost of a top quality electric domestic hot water system would have to be subtracted out before the costs saved by such systems would make them competitive with Kootenai Falls dam.

Active Solar Space Heating Systems

Active solar space heating systems work much the same as SDHW systems. Such systems are used only during the heating season, which raises the cost of the energy they supply to a higher cost per Btu than from SDHW systems, which operate year round. Inasmuch as energy from SDHW systems is cheaper than from active space heating systems while still costing more than energy from Kootenai Falls, the active systems appear to not be economically competitive with energy from the proposed dam.

Wind

Wind energy conversion systems (WECS) can produce electricity, heat, and mechanical energy (Cartwright 1982g). Wind turbine generators that produce electricity are commercially available, though they still are relatively expensive compared to conventional forms of generation. WECS that produce heat are not yet commercially available, and WECS that produce mechanical energy - such as windmills that pump water - have limited applicability in the WMED service area.

The potential value of electric generation by wind turbines is extremely site-specific. Slight variations in wind speed mean major variations in output because the amount of wind power is a function of the cube of the wind speed. Although comprehensive wind resource data on Montana is lacking, several regions within the WMED service area appear to have excellent wind regimes, with the two most promising being near Whitehall and Cut Bank. Wind speed in the WMED service area peaks in the winter months, and would tend to match the WMED annual load pattern.

The costs for electricity from wind turbines evaluated by DNRC are presented in table 5-9, along with the cost of power from Kootenai Falls dam. These estimates are based on feasibility studies and on initial production runs at small production facilities. Mass production of wind machines might lower the cost of wind generated electricity in the future.

TABLE 5-9. COST OF ELECTRICITY FROM WIND TURBINES

Type Facility	Single Generator Capacity	Cost
Boeing MOD-2	2,500 kW	37.2 mills/kWh
Carter Mod-25	25 kW	60.3 mills/kWh
Kootenai Falls Dam		21.6 mills/kWh

Small Hydro

Most of the low capacity hydroelectric generating plants proposed or under construction in the WMED service area range between 50 kW and 750 kW (Cartwright 1982h). DNRC refers to hydro facilities with a capacity less than 15 MW as "small hydro." Small hydro development is distinguished by the small amount of construction required. Often a dam is not necessary. Small hydro installations are feasible under a large range of heads (i.e., difference in elevation between the water intake and the turbine) and require only small amounts of water.

The cost of a small hydro plant depends on site-specific conditions. For instance, at sites with a high head, the cost of the penstock (the pipe between the water inlet and the turbine) can account for over half the material costs. The construction time is short, often less than six months, which reduces the cost of the construction loan and the chance of installing excess capacity. An examination of three small hydro plants in Idaho provides some idea of the costs for such installations. The three are a 250 kW plant near Clark Fork, a 380 kW plant near Shoshone, and a 532 kW plant near Buhl.

The levelized costs for electricity from these facilities are shown in table 5-10, with Kootenai Falls estimated costs shown for comparison. These plants represent the types of small hydro plants that are coming on line in and near the WMED service area.

TABLE 5-10. COST OF ELECTRICITY FROM SMALL HYDRO

Facility	Cost
Clark Fork	20.8 mills/kWh
Shoshone	13.9 mills/kWh
Mud Creek	14.5 mills/kWh
Kootenai Falls	21.6 mills/kWh

Estimation of the amount of small hydro that could be developed in western Montana requires more data than currently are available. There undoubtedly is a large amount of this resource, given the numerous mountain streams and extensive irrigation projects and the recent wave of applications to FERC to develop small hydro sites in the WMED service area. As of March, 1982, FERC had issued preliminary permits for 19 sites in Lincoln County with a total capacity of 3.8 MW and for 10 sites in Lake County with 3.1 MW total capacity.

Environmental Impact of Small Hydro. The environmental impact of a small hydro plant depends on the specific site. Diversion dams and other structures placed in streams could cause erosion because of ice and debris jams and altered stream hydraulics. Where no dam is necessary, major impacts occur only if new access roads and/or seasonal dewatering of a portion of the stream are required. New access roads might be necessary to get to the site, to lay pipe, or to string transmission wire, and right-of-ways for the pipe and transmission line would have to be cleared and maintained. During low water months, diversion of water to the plant could lower the stream level between the diversion point and the turbine house to a degree unacceptable for maintaining the fisheries. It is conceivable that some project designs could cause serious problems by blocking spawning runs and severely dewatering important invertebrate production areas or fish spawning sites in small streams. Streams with a steep gradient are not used by upstream migrants, but if there are lakes or sections of gentle gradient upstream from the steep gradient, there could be some downstream drift of fish over the steep portion. This drift could be important in some places as a supply of fish to downstream stretches. The seriousness of the impacts would depend on the length of stream dewatered, the size of the stream, and the percentage of the flow diverted. Invertebrate productivity in the project area probably would be lost, with a consequent decline in the amount of fish food available onsite and downstream. A review of 75 applications in the Kootenai and Clark Fork drainages indicated that about one-half of the proposed small hydro projects would adversely affect fisheries (Lockard 1982). Many environmental impacts could be avoided or reduced if plants were kept small enough to leave some water in the streams, and were built near existing roads and transmission lines.

One major advantage of small hydro over conventional hydro projects is the diffusion of construction impacts over time and geography. The small scale of the projects would preclude any boom and bust social and economic impacts associated with large scale engineering projects. Most impacts from small hydro would result from construction and maintenance of trails, roads, and transmission corridors rather than flooding of the land.

Institutional Considerations. Institutional barriers to the construction of small hydro facilities are much the same as for conventional facilities, though overcoming them is less difficult. The site must be leased or purchased. Competition for prime sites could be intense, since federal (e.g. PURPA) regulations have increased the economic attractiveness of installing small hydro facilities. Permits must be obtained from a variety of government agencies, but small hydro facilities are perceived to have less environmental impact, so the permitting process is less complicated and less time consuming than with conventional facilities. FERC waives many requirements for small hydro and the state has yet to require an environmental impact statement.

Biomass

The term "biomass" refers to plant and animal matter such as wood, straw, manure, and garbage. This matter contains stored energy that originated from the sun and can be tapped in a number of ways. One of the most promising uses of biomass is direct combustion.

This analysis covers the use of residential wood heating systems and garbage-fired steam and electric plants, both examples of direct combustion technology. Another common use of biomass is anaerobic digestion, which is the controlled decomposition of organic matter such as manure in the absence of oxygen. Manure and straw are locally plentiful in some parts of the WMED service area, although most of the feedlots and the main grain-growing areas of the state are elsewhere (Montana Department of Agriculture 1980). Anaerobic digesters and straw combustors therefore were not considered.

Wood Heating

The wide variety of wood-fired heating systems may be divided into three categories: fireplaces, stoves, and furnaces (Cartwright 1982c). Their net efficiencies (net amount of heat added to the house divided by energy content of the wood burned) range from less than zero up to 90 percent.

The traditional masonry fireplace is extremely inefficient for heating a house. The stack effect of the chimney increases infiltration of cold outside air into the house to such an extent that fireplaces have a negative net efficiency during the coldest weather, and actually add to the demand for electricity during cold weather. Because of their low efficiency, fireplaces were not considered as an alternative.

The most common sort of wood-fired heating system is the airtight stove. Airtight stoves permit the operator to control the rate of wood combustion by regulating the amount of oxygen admitted to the combustion chamber. These stoves have a net efficiency of 40-70 percent (Shelton and Shapiro 1976; Maxwell et al. 1981), with 50 percent being typical.

Furnaces are the third major type of wood burning systems. Their efficiency ranges between 40-60 percent (Maxwell et al. 1981). A few furnaces are designed to burn the wood quickly at extremely high temperatures, with the resultant heat stored in some sort of thermal mass. These units have an efficiency of 80-90 percent (Cartwright 1982c), which means less pollution and less work and expense for the operator.

Wood is widely used for heating in the WMED service area. Approximately 54 percent of all living units have a wood stove. Thirty-six percent use the stove as the main source of heat, and 18 percent use it as a secondary source. Another 9 percent of all houses use fireplaces, primarily as a secondary source of heat. Use of wood in 1980 was more prevalent in newer living units than older ones, with the highest use being in single family houses built since 1975; wood systems supply an estimated 60 percent of the entire load of all new houses (see Energy Efficient New Homes above). Given the current saturation, any effort to decrease WMED's need for electricity by increasing the use of wood could have only a small effect.

Adverse Impacts of Wood-Burning Systems. The environmental health concerns related to the use of wood stoves is one of their major drawbacks (Rubich 1981c). There is abundant evidence indicating that dense concentrations of wood smoke can be detrimental, especially to sick, elderly, and young persons. Although air-tight stoves are more thermally efficient than open fireplaces, tests indicate their use increases production of potentially dangerous air contaminants as compared to fireplaces (Hall and DeAngelis 1980). A wide range of studies indicate great variations in the composition of wood smoke and soot, both of which contain many organic condensates. Most of the particulate emitted is small enough to bypass the natural filtering mechanisms that normally prevent particulates from entering the lung. Once particles of this size enter the deep lung, they may overcome removal mechanisms and remain for long periods. Seventeen of the compounds found as a gas or particulate in wood smoke have well-documented adverse effects on human health. An additional 14 known carcinogenic agents and four known co-carcinogens are found in atmospheric woodsmoke concentrations. Six or more compounds have been shown to be cilia-toxic or mucus coagulating, thus reducing the cleansing capacity of the lung. Along with these compounds are large volumes of carbon monoxide, a lethal gas, and respiratory irritants such as aldehydes and phenols. Creosote or soot has been shown to contain benzo(a) pyrene, a strong carcinogen, and dioxin.

Garbage

Garbage can be burned to produce steam, or steam and electricity (Cartwright 1982i). Garbage is not a major renewable resource in Montana, because of the small, dispersed population. Most of the waste that is produced comes from cities and towns outside the WMED service area, many of which are developing plans to use their garbage themselves.

For these reasons, the use of garbage to produce energy is not an alternative to Kootenai Falls dam.

Geothermal

When available in sufficient amounts, heat generated deep within the earth's crust can be used for space heating, industrial processes, and to run turbines to generate electricity (Cartwright 1982j).

The presence of hot springs is a good indication of geothermal potential, and many such springs are found in the WMED service area. The temperature in most of the springs ranges between 105-125 degrees F. Temperatures in wells drilled at a geothermal resource can be higher (e.g., 170 degrees F. in a well at Warm Springs Hospital), but still are below the temperatures necessary for generating electricity. These temperatures are adequate for space heating and some other uses, but few geothermal resources are near potential end-users.

Geothermal resources were ruled out as an alternative to the proposed prject because of the small amount available, and their low temperatures and remote location.

CHAPTER SIX — ECONOMICS OF THE PROPOSED PROJECT

This chapter discusses the expected increases in demand for electricity in the service area of WMED, and the various economic aspects of the proposed project, including a cost-benefit analysis.

The reader will note that this chapter contains some overlap of attribution between WMED and WMEG&T (Western Montana Electric Generating and Transmission). WMED was formed specifically for purposes of applying for authorization to construct the power plant at Kootenai Falls, whereas WMEG&T was organized for a broader range of rural electrification services. The Flathead Irrigation and Power Project is the only member of WMED that is not also a member of WMEG&T. The group is referred to as WMEG&T only when the action referenced was performed in the official capacity of WMEG&T (for example, the issuance of publications or information regarding their service area).

ELECTRICITY LOAD GROWTH AND THE COMPARISON OF ALTERNATIVES

INTRODUCTION

DNRC used three steps in evaluating electric load growth. The first step was evaluation of the future demand for electricity in the WMED service area. Future demand will be determined by the growth of population and economic activity, the type and number of electrical devices used, and the intensity of their use. Demand also will be affected by the future price of electricity.

The second step was an evaluation of alternate ways of supplying electricity, such as purchases from BPA, building the proposed dam, other alternatives discussed in chapter five, and combinations of these supply sources.

The third step was to combine the demand projections with the alternative sources of supply to determine the future prices of electricity and load patterns associated with each source or combination of sources.

This section explains the methods used by the applicant and by DNRC to construct forecasts of the future demand for electricity. DNRC's demand forecasting model is then used to determine load projections for each combination of energy sources.

FORECASTING METHODS

There are four basic methods for projecting load growth and the demand for electricity. These are trending, engineering end-use analysis, econometric modeling, and judgment.

Trending is based on the assumption that future rates of change in electrical loads will be the same as those in the recent past.

In the engineering end-use approach, the number of electrical appliances in use (including electric space heating systems) and the amount of electricity used by each are estimated. The total amount of electricity used by all appliances annually equals the total annual electrical consumption. This method usually entails a survey of customers in the service area to determine the number and type of electrical appliances in use. Each surveyed customer is asked to estimate the number and type of appliances he or she expects to add in the next few years, including conversion to electric space heating or conversion from electric space heating to another fuel such as wood or natural gas.

Econometric models are composed of a series of mathematical equations. The values and relationships of variables in the equations are based on historical data, current survey data, and on economic theories such as the effect of price increases on supply and demand. The principal disadvantage of econometric modeling is that it requires data in quantities which are not always available, and it is expensive.

Judgment is the method by which the forecaster, relying on expert knowlege of the category for which a forecast is being made, predicts a future pattern of load growth. Although this obviously is a subjective method, it sometimes is the only practical way of forecasting energy use in certain customer classifications, and in some cases is the only appropriate method for incorporating nonstatistical information into statistical forecasts.

Most actual forecasting efforts rely on combinations of these methods. In particular all models rely to some degree on judgment if only in the selection of the values of independent variables.

The type of forecasting methods used depends upon the availability of necessary data, and whether it is worth the expense to use more costly and complex methods to obtain more valid and useful forecasts than otherwise would be available. DNRC's forecast used the best end-use and customer-behavior survey data available, the prices of electricity and competing fuels, household income and population growth.

WMED's Forecasting Methods

WMED prepared separate load forecasts for each load class (WMEG&T 1981). The classes are residential, seasonal, irrigation, small commercial (defined as commercial loads under 50 kVA (kilovoltampere, approximately the same as one kilowatt), large commercial under 350 kVA, large commercial over 350 kVA, street lighting, WMED's own use, and line losses. For all sectors except large commercial, the applicant employed a combination of engineering end-use analysis, trending, and judgment to forecast loads. In the residential sector, WMED based its projections on a survey of electrical appliance use by current customers, and an estimate of how those patterns would change in the future (WMEG&T 1981: for discussion see Skeel and Bagby 1981). The projection of residential load was based on an estimated population growth rate of 4.5 percent per year.

WMED's forecasts for nonresidential sectors (other than large commercial) are based upon trends established during a period of declining real electricity prices. Considering that the next decade will include periods of increasing electricity prices, the accuracy of the forecasts may be in doubt.

WMED used informed judgment in projecting the growth of large commercial loads. Neither trending nor statistical methods are applicable for predicting changes in large commercial loads, because the loss or addition of one large customer can produce dramatic reductions or increases in the total load. Furthermore, the relatively diverse nature of end-uses among large commercial customers precludes end-use analysis.

WMED's Forecast

Table 6-1 shows WMED's 1979 actual loads and the forecast loads by customer class through 1998. Table 6-2 shows the number of customers in 1979 and the forecast number of customers by class through 1998. In testimony presented to FERC in February 1982, WMED presented revised forecasts as shown in figure 6-1. No further details were available, so the remainder of this discussion pertains to forecasts in the Power Requirement Study (PRS) from 1981.

Table 6-3 gives the percentage of households with a given appliance (saturation rate) in 1979 and the forecast percentage for future years, and typical usage figures projected by WMED. A close examination of the table reveals the assumptions of the WMED forecast. For example, the saturation percentage for electric resistance heat is projected to nearly double between 1979 and 1984, increasing from 28 percent to 55 percent. Thus, WMED has forecast that large numbers of customers will switch to electric resistance heat, and away from other types of heating. The annual use of electric resistance heat decreases by 34 percent from 1979 to 1984, suggesting that the consumers will be reducing the use of their heating system by conserving.

DNRC concluded that WMED's forecasting methods did not explicitly account for the effect of rising electricity prices on the demand for electricity, and overpredicted the likely rate of population growth. These shortcomings and the availability of new survey data more recent than those available to WMED led DNRC to perform its own forecast of the future demand for electricity in the WMED service area.

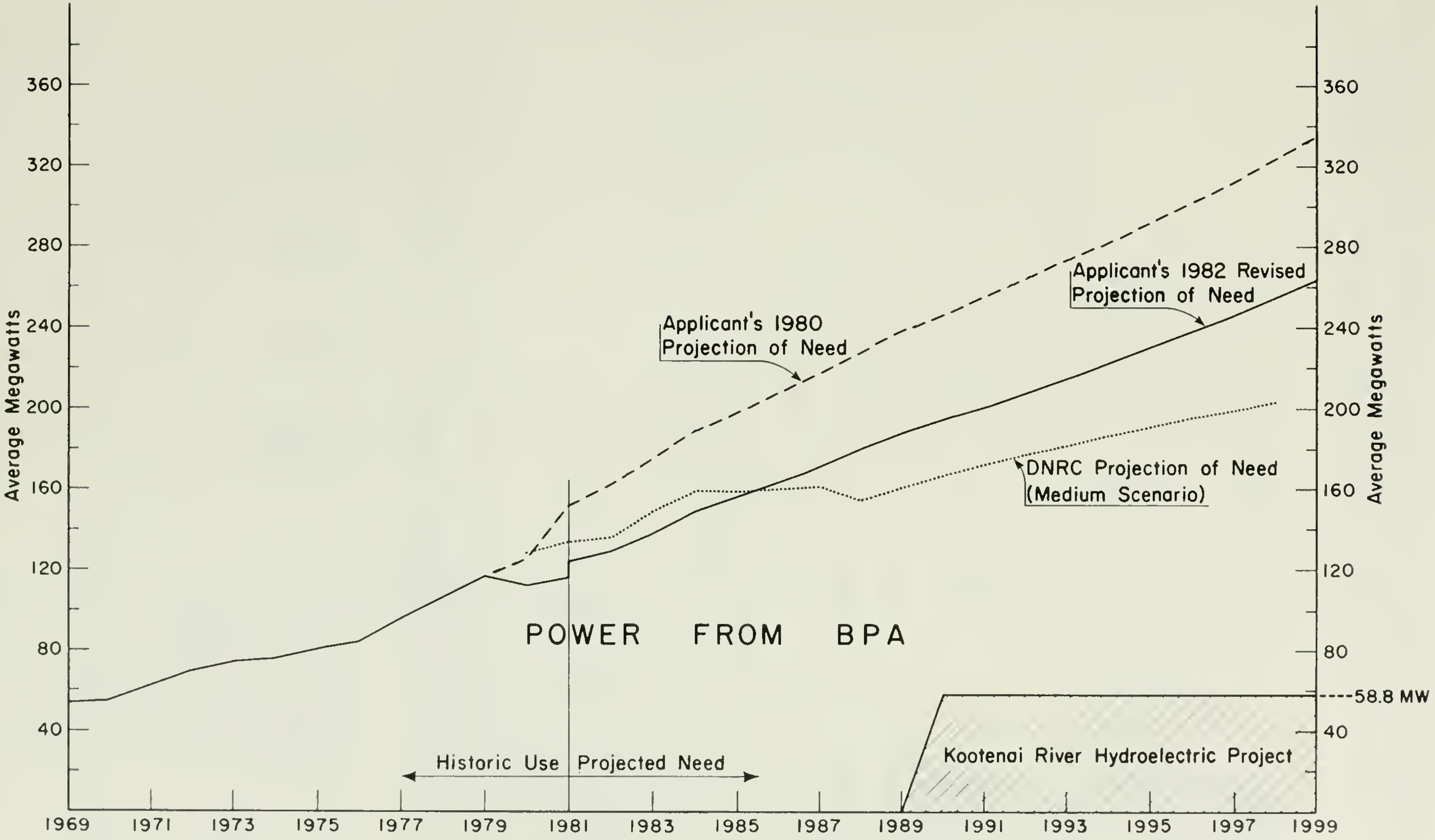

FIGURE 6-1. LOAD ESTIMATES

Source: Northern Lights, Inc. as modified by DNRC

TABLE 6-1. WMED'S FORECAST LOAD BY CUSTOMER CLASS (average MW)

	1979 (recorded use)	1984	1989	1998[a]	Annual % increase 1979-1998
Residential	62.65	95.38	126.97	181.61	5.8
Seasonal[b]	2.00	3.01	4.18	6.04	6.0
Irrigation	9.99	12.68	15.29	18.94	3.4
Small Commercial	15.97	21.28	27.74	36.60	4.5
Street Lighting[c]	.19	.21	.24	.25	1.5
Own Use	1.43	1.60	1.65	1.79	1.2
Large Commercial under 350 kVA	3.64	4.65	6.53	9.12	5.0
Large Commercial over 350 kVA	10.26	32.00	33.90	39.17	7.3
Line Losses[d]	10.91	17.47	22.59	30.54	19.7
TOTAL	117.04	188.73	239.09	324.06	5.5

[a] *The last year of the applicant's forecast is 1999. The value for 1998 was interpolated for ease of comparison to the DNRC forecast.*

[b] *This is mainly summer homes and recreational cabins that are used only part of the year.*

[c] *Includes only that street lighting covered by a street lighting rate contract.*

[d] *Electricity lost in the process of transmission and distribution.*

Source: WMEG&T 1981

TABLE 6-2. WMED'S FORECAST NUMBER OF CUSTOMERS BY CLASS

	1979*	1984	1989	1998**
Residential	33,581	43,778	54,277	72,328
Seasonal	5,201	5,912	6,606	7,740
Irrigation	2,793	3,600	4,233	4,955
Small Commercial	4,960	5,822	6,790	8,533
Street Lighting	33	34	36	38
Large Commercial Under 350 kVA	171	206	244	316
Large Commercial Over 350 kVA	39	54	63	85

* *Actual reported numbers.*

** *The last year of the WMED forecast is 1999. The value for 1998 was interpolated for ease of comparison to the DNRC forecast.*

Source: WMEG&T 1981.

TABLE 6-3. WMED'S FORECAST APPLIANCE USE PATTERNS

(number of each appliance per 100 households)

	1979		1984		1989	
	Saturation (percent**)	Energy Usage (annual kWh)	Saturation (percent)	Energy Usage (annual kWh)	Saturation (percent)	Energy Usage (annual kWh)
Electric resistance heat	28	19,830	55	14,813	54	16,739
Television	119	294	119	291	120	294
Freezer	84	1,102	85	1,096	86	1,093
Washer	91	90	91	90	92	90
Dryer	83	986	84	953	84	951
Range	84	1,181	85	1,144	86	1,138
Dishwasher	50	368	51	364	53	368
Water Heater	81	4,782	82	4,477	83	4,412
Engine Heater	111	460	112	449	112	440
Stock Heater	36	733	36	702	34	701
Electric Heat Pump	3	9,996	4	9,057	5	8,766
Base Load***	100	2,982	100	2,884	100	3,213

[*] *The figures given in this table were compiled from the individual PRSs of the member cooperatives. The WMED PRS did not contain this information. Even though the WMED PRS says that its results are derived from the individual members' PRSs, residential forecasts made from tables 6-2 and 6-3 (by multiplying saturation times usage times number of consumers and summing over appliance types) will not produce the same results as given in table 6-1; however, the difference is not significant for purposes of discussion. The WMED PRS gives no explanation of why the figures differ.*

[**] *Saturation equals number of appliances used in WMED's service area divided by the number of customers in the service area; 1979 figures are based on a survey by WMED.*

[***] *Base load is electrical use of all other appliances, e.g., mixers, toasters, etc., not included in a separate category.*

DNRC Load Forecasting Method

DNRC constructed an econometric forecasting model incorporating statistical equations that evaluate how demand is affected by rising electricity prices, the costs of competing fuels, local income changes, and population growth. DNRC's model also incorporates end-use survey data gathered by the Pacific Northwest Utilities Conference Committee (PNUCC) (Elrick and Lavidge 1980) and WMED (WAI 1981b). DNRC developed econometric models to forecast the loads of three customer classes — residential, small commercial, and irrigation (Skeel and Bagby 1981). For the other sectors, DNRC used methods similar to those used by WMED, but with some different assumptions. DNRC's projections are based on a customer growth rate of 1.3 percent per year (Skeel and Bagby 1981).

The methods DNRC employed explicitly account for the effect price will have on the demand for electricity. The price of electricity is determined in part by the cost of the resources used to produce the electricity, and in part by the costs of distribution and administration, and by financial obligations such as the indebtedness on the abandoned WPPSS nuclear power plants. The cost of supplying electricity in the near future will increase as more is produced, because new sources of power probably will be more expensive than existing sources. However, if the price of electricity increases, people will conserve more by implementing conservation measures such as insulating and weatherstripping or by switching to other fuels for heating.

Two other key elements contributing to the demand for electricity are population growth in the service area, and income, which determines the ability to pay for electricity. The econometric model explicitly incorporates estimates of future values of these variables.

In order to determine how various rates of population growth affect electricity demand, DNRC produced a low and medium scenario on the basis of two estimates of population growth, both of which were lower than the growth rate estimated by WMED (DCA 1981, BPA 1981), and used WMED's estimate of population growth rate to develop a high scenario.

DNRC constructed several demand scenarios using different assumptions about the variables that affect load growth. Table 6-5 presents the assumed values for each scenario. The values are chosen so that the low scenario is characterized by assumptions leading to low electricity consumption (e.g., low population growth and low prices of alternate fuels). The high scenario is characterized by assumptions leading to high electricity load growth (e.g., rapid population growth and high prices for alternate fuels).

Models for both the irrigation and small commercial classes estimate aggregate demand (the consumption of the entire sector, rather than of individual consumers within the sector). They employ historical data from the WMED service area for econometric estimation. Like the residential models, the small commercial model forecasts a range of consumption scenarios based on the price of electricity, population, and income (Burt 1981). The irrigation model forecasts consumption of the irrigation sector given the number of irrigation pumps and the price of electricity (Colorado School of Mines Research Institute 1981). DNRC accepted the number of pumps projected by WMED, so only one scenario has been prepared for the irrigation sector.

Loads for large commercial, street lighting, WMED's own use, and line losses, are forecast using methods similar to WMED's mix of trending and judgmental techniques. DNRC forecasts for these loads differ from WMED's forecast only when DNRC disagrees with WMED on likely rates of growth in the number of customers.

DNRC Forecast

Future electricity prices depend upon the supply sources used. As explained in the following section on Supply Demand Integration, DNRC evaluated five different supply models. In order to illustrate how the models work, DNRC developed table 6-4 to show the forecast consumption of each customer class for 1989, 1994, and 1998, based on the assumption that all power was purchased from BPA. The price of BPA power is based on recently announced BPA price increases for 1981-1985, and on BPA's projections of likely prices after 1985 (DOE 1982). The latter are highly uncertain, and actual future prices could be quite different, depending on the amount, type, and cost of new energy sources acquired by BPA. If higher prices are assumed, the models would forecast a lower demand; conversely, if a price lower than BPA rates were assumed, the models would forecast a higher demand.

TABLE 6-4. DNRC FORECAST FOR EACH CUSTOMER CLASS

(assumes all power from BPA)

	Residential	Seasonal	Small Commercial	Irrigation	Large Commercial (under 350 kVA)	Large Commercial (over 350 kVA)	Own Use	Street Lighting	Line Losses	TOTAL
Low Scenario (low population growth, low alternative fuel prices, low growth in family income)										
1984	71.38	2.16	19.28	11.60	4.72	32.00	1.60	.21	13.44	156.39
1989	72.16	2.33	22.45	12.49	5.61	33.90	1.65	.24	14.18	165.01
1994	82.38	2.51	24.05	14.44	6.03	36.65	1.75	.25	15.80	183.83
1998	90.18	2.65	25.06	16.20	6.31	39.14	1.79	.25	17.07	198.65
Medium Scenario (moderate population growth, moderate alternate fuel prices, moderate growth in family income)										
1984	73.91	2.24	19.32	11.60	4.74	32.00	1.60	.21	13.69	159.31
1989	76.39	2.44	22.73	12.49	5.69	33.90	1.65	.24	14.62	170.15
1994	86.17	2.58	74.78	14.44	6.25	36.65	1.72	.25	16.25	189.09
1998	92.84	2.68	26.19	16.20	6.65	39.14	1.79	.25	17.46	203.20
Modified Medium Scenario (high population growth, moderate alternative fuel prices, moderate growth in family income)										
1984	83.26	2.24	19.32	11.60	4.74	32.00	1.60	.21	14.57	169.54
1989	98.60	2.44	22.73	12.49	5.69	33.90	1.65	.24	16.71	194.45
1994	124.00	2.58	24.78	14.44	6.25	36.65	1.72	.25	19.20	230.47
1998	146.23	2.68	26.19	16.20	6.65	39.14	1.79	.25	22.48	261.61
High Scenario (high population growth, high alternative fuel prices, high growth in family income)										
1984	84.13	3.01	19.32	11.60	4.74	32.00	1.60	.21	14.72	171.33
1989	102.43	4.18	22.72	12.49	5.69	33.90	1.65	.24	17.23	200.53
1994	127.61	5.13	24.73	14.44	6.24	36.65	1.72	.25	20.38	237.15
1998	149.35	6.04	26.12	16.20	6.63	35.14	1.79	.25	23.08	268.60

The basis for forecasting the high, medium, and low residential loads is given in table 6-5. The difference between DNRC's medium scenario and the WMED's forecast is substantial and lies partly in differing estimated growth rates of the number of residential customers, and on the price response built into the DNRC forecast. This is shown in table 6-6, which compares the WMED forecast to DNRC's medium scenario, which uses customer increase projections based on BPA population growth predictions. Also shown are two modified versions of DNRC's medium scenario. These were constructed using all the assumptions of the medium demand scenario except for growth in population which was taken from WMED and is identical with the assumption used in DNRC's high scenario. One variation uses projected prices described below in Supply Demand Integration; the other assumes a much slower rate of increase in prices. Thus, for the residential sector in 1994, 60 percent (53 average MW) of the 89 average MW difference between DNRC's medium scenario forecast and the WMED forecast is due to differing assumptions about the rate of growth in the number of customers. At least an additional 18 percent (16 average MW) can be accounted for by the explicit price response in the DNRC model.

TABLE 6-5. VARIABLES USED IN DNRC RESIDENTIAL FORECASTS

	LOW SCENARIO				MEDIUM SCENARIO				HIGH SCENARIO			
	1984	1989	1994	1998	1984	1989	1994	1998	1984	1989	1994	1998
Number of Households[a]												
Single Family Dwellings	30,566	33,020	35,457	37,451	31,493	34,248	36,305	37,605	35,610	44,557	52,852	60,064
Multi-family Dwellings	869	939	1,008	1,065	895	974	1,032	1,069	1,012	1,267	1,503	1,708
Mobile Homes	6,348	6,857	7,363	7,777	6,540	7,112	7,539	7,809	7,395	9,253	10,975	
Price of Electricity (mills/kWh)	36.63	46.26	45.79	45.54	36.63	46.16	45.79	45.54	36.63	46.16	45.79	45.54
Price of Alternative Fuels[b]												
Natural Gas ($/MMBtu delivered)	7.65	9.27	11.05	12.59	7.65	9.27	11.05	12.59	7.65	9.27	11.05	12.59
Fuel Oil ($/MMBtu delivered)	18.37	21.32	25.32	27.15	18.96	23.71	28.96	33.38	20.10	31.20	43.56	55.84
Income[c]												
Single Family Dwelling	18,769	20,925	23,297	25,385	18,855	21,073	23,533	25,746	18,921	21,241	23,845	26,157
Multi-family Dwelling	15,355	17,073	19,008	20,712	15,383	17,194	19,217	21,006	15,438	17,330	19,455	21,341
Mobile Homes	15,215	16,939	18,858	20,549	15,263	17,059	19,066	20,841	15,317	17,194	19,303	21,174
Number of Occupants[d]												
Single Family Dwellings	3.02	2.93	2.85	2.79	3.02	2.93	2.85	2.79	3.02	2.93	2.85	2.79
Multi-family Dwellings	2.86	2.77	2.70	2.65	2.86	2.77	2.70	2.65	2.86	2.77	2.70	2.65
Mobile Homes	2.90	2.81	2.74	2.68	2.90	2.81	2.74	2.68	2.90	2.81	2.74	2.68

[a] *The number of customers in 1980 was taken from the WMED survey (WAI 1981b) and from the WMED PRS (WMEG&T 1981). The rate of growth in the low scenario is derived from estimates by DCA (1980); in the medium scenario, from BPA (1981); and in the high scenario, from WMED (1981).*

[b] *The 1981 prices of natural gas and fuel oil were determined by a survey of dealers in the WMED service area. The rates of increase in price of fuel oil for the low and high scenario are from BPA (1981), and for the medium scenario, from PNUCC (1981). The rate of increase in the price of natural gas was provided by BPA (1981). All values are in 1981 dollars. Costs are for heat actually provided to the living unit.*

[c] *Estimates are derived from a review of the literature (Skeel and Bagby 1981). All values are in 1979 dollars.*

[d] *The WMED survey (WAI 1981) provided the actual number of occupants per dwelling in 1980. The rates of change in number of occupants was provided by BPA (1981).*

TABLE 6-6. FORECAST COMPARISON AVERAGE MW

(Average MW)

TOTAL LOADS

	WMED's Forecast	DNRC Medium Scenario	DNRC Modified Medium Scenario	DNRC Modified Scenario, Low BPA Prices
1984	188.7	159.1	168.4	172.6
1989	239.1	169.7	191.9	206.8
1994	278.0	188.6	226.5	244.9
1998	324.1	202.8	256.2	277.7

RESIDENTIAL SECTOR LOADS

	WMED's Forecast	DNRC Medium Scenario	DNRC Modified Medium Scenario	DNRC Modified Scenario, Low BPA Prices
1984	95.4	73.9	83.3	86.7
1989	127.0	76.4	98.6	110.4
1994	155.0	86.2	124.4	138.0
1998	181.6	92.8	146.2	162.5

The forecast loads for seasonal (i.e., summer home) customers are the products of average use per customer and number of customers. WMED forecast an increase of 5 percent per year in seasonal per customer consumption through 1989, and 2.4 percent thereafter through 1999. DNRC sees no reason for seasonal consumption to increase at such rates and assumes that response to higher prices and more efficient appliances, will cause seasonal per customer use to remain at its current level. WMED's estimate of seasonal customer use increases was used in developing the high scenario and DNRC's assumption was used in the medium and low scenario. The projected rates of growth in the number of customers are the same as used in the residential model.

Table 6-7 contains the basis used in forecasting the load for the irrigation and small commercial customer classes. For a discussion of the methods used by the applicant and DNRC to obtain these forecasts, see Skeel and Bagby 1981.

DNRC assumed that loads in the large commercial (under 350 kVA) customer class will grow at the same rate as those in the small commercial class, or an average of 4.2 percent per year through 1989 and 2.0 percent thereafter through 1998, compared with the WMED forecast of 6.0 percent through 1989 and 3.8 percent from 1989 through 1999. DNRC doubts that growth in this class will be that much greater than growth in the small commercial class, in that future increases in electricity prices will tend to slow growth in use, and the population in the service area is unlikely to increase fast enough to support the expansion in the number of firms that WMED predicts. DNRC assumptions are used in the low and the medium scenarios; WMED's forecast is used in the high scenario.

DNRC adopts WMED's judgmental forecast for the large commercial (over 350 kVA) customer class. Most of the customers in this class are sawmills or mining operations. Much of the load increase in this sector is due to the addition of the ASARCO Mt. Vernon mine near Bull Lake; over two-thirds of the increase in use between 1979 and 1984 goes to ASARCO. The WMED forecast is used for all three scenarios in this category.

DNRC accepts the WMED estimates of its own energy consumption, its estimate of future line losses, and its forecast of usage for street lighting.

TABLE 6-7. VARIABLES USED IN DNRC SMALL COMMERCIAL AND IRRIGATION FORECASTS

	LOW				MEDIUM				HIGH			
	1984	1989	1994	1998	1984	1989	1994	1998	1984	1989	1994	1998
Small Commercial												
Price of Electricity (mills/kWh)[a]	38.01	47.92	47.42	47.17	38.01	47.92	47.42	47.17	38.01	47.92	47.42	47.17
Population[b]	294,659	316,224	331,562	341,470	294,659	316,224	331,562	341,470	294,659	316,224	331,562	341,470
Income[c]	2,396,511	2,711,433	3,067,737	3,386,207	2,443,616	2,854,887	3,316,023	3,732,213	2,472,210	2,919,226	3,464,776	3,928,856
Irrigation												
Price of Electricity (mills/kWh)[d]	38.02	47.88	47.42	47.20	38.02	47.88	47.42	47.20	38.02	47.88	47.42	47.20
Number of Pumps[e]	3,487	4,166	4,814	5,407	3,487	4,166	4,814	5,407	3,487	3,487	4,166	5,407

a Actual average price to small commercial consumer in 1980 as reported by REA (USDA 1981) was used as the initial price. Rate growth in the price is derived from BPA's estimated rate of growth in its wholesale prices and assuming other costs remain constant in real terms (Nordell 1982b). All values in 1979 dollars.

b Estimated total population of counties served by WMED (DCA 1980).

c Total nonfarm disposable income of all people in counties served by WMED estimated from a review of literature (Skeel and Bagbyd 1981). All values in 1979 dollars.

d Actual marginal price to the consumer in 1980 as found in the rate schedules of the cooperatives was used as the initial price. Rate of growth is derived from BPA's estimated rate of growth in wholesale prices. Values given are for Vigilante Electric Cooperative irrigation customers. Prices for Ravalli Electric Cooperative irrigation customers are 14.8 percent higher than shown; .8 percent less than shown for Flathead Irrigation Project customers and for others 10.9 percent higher than shown.

e WMED's estimated future number of pumps (MNEG&T 1981.)

SUMMARY

The accuracy of future electricity demand forecasts depends on the methods and the assumptions used. DNRC considered those used by WMED for residential, small commercial, and irrigation sectors to be inadequate, and therefore developed its own. However, much of the difference in the results is derived from different assumptions about population growth in the WMED service area. Another major consideration in DNRC's model is consumer response to electricity price changes, which was not considered in the WMED approach. DNRC used a variety of assumptions to prepare four demand scenarios. DNRC contends that the assumptions of the medium scenario are the most likely to represent the actual situation. Using the medium scenario, and assuming that all power is supplied to WMED by BPA. DNRC forecasts that WMED's load will be 189.09 average MW in 1994 and 203.20 average MW in 1998, compared with WMED's forecast of 278 average MW in 1994 and 324 average MW in 1998. The 1979 load was 117 average MW, so DNRC's forecast represents an average annual load growth of 2.8 percent over the 1979-1998 period, compared with 5.5 percent forecast by WMED.

SUPPLY-DEMAND INTEGRATION

SUPPLY OPTIONS EVALUATED

Of the numerous potential sources of electricity it examined, DNRC selected five for more detailed analysis on the basis of the availability, cost, and low environmental impact. Some of these are single sources and some are combinations of sources. For convenience, the five supply options are labeled BPA, Proposed Project, Conservation/Retrofit, Dam/Conservation/Retrofit, and Colstrip. Some power would be purchased from BPA under any of the supply options, because none of them alone could supply the expected demand. The cost of energy would be different for each of the supply options.

The choice of supply options is somewhat arbitrary and there is a large number of others that could have been examined. For example, the Conservation/Retrofit option includes retrofits at three existing dams for which cost estimates were readily available. There are about 660 dams in Montana that might be adaptable to retrofit, but adequate economic information was not available for any but the three.

With the BPA supply option, BPA would supply electricity to meet all the future needs of WMED. The Proposed Project option includes the supply of 58.8 average MW from the proposed dam at Kootenai Falls, with loads above this level served by purchases from BPA. The Dam/Conservation/Retrofit option includes the 58.8 MW from Kootenai Falls along with an additional increment of power with a levelized cost equal to or lower than power from the proposed project: 3.8 average MW from conservation measures; [3.4 from weatherization of houses and .4 MW from water heater wraps]; and 10.3 average MW from installation and operation of generators at three existing dams for a total of 72.9 average MW. The Conservation/Retrofit option would exclude the Kootenai Falls dam and include the same conservation and dam retrofits as in the Dam/Conservation/Retrofit option, for a total of 14.1 MW. In the case of the Dam/Conservation/Retrofit option, loads in excess of 72.9 average MW would be served by purchases from BPA. The Colstrip supply option assumes the availability of 73.5 average MW from a 7 percent share in Colstrip 3 and 4, with loads in excess served by BPA. The figures in table 6-8 show the cost of power from each source without considering the price of the BPA power that would be added to each to meet the loads.

TABLE 6-8. COST OF ELECTRICITY FROM ALTERNATE SUPPLY OPTIONS

(1981 mills/kWh)

Year*	BPA	Proposed Project	Colstrip	Weatherproofing 1 & 2 story houses	Installing water heater wraps	Broadwater	Painted Rocks	Clark Canyon
1982	11.55							
1983	19.06							
1984	17.66							
1985	22.94							
1986	25.46		40.29					
1987	29.18		37.92					
1988	29.18	57.28	35.81	28.22	11.09	36.04	41.96	18.91
1989	29.18	52.38	33.88	25.90	10.15	33.08	38.70	17.44
1990	29.18	47.94	32.14	23.79	9.29	30.40	35.74	16.12
1991	29.18	43.92	30.57	21.89	8.51	27.96	33.05	14.91
1992	29.18	40.26	29.15	20.15	7.80	25.75	30.62	13.82
1993	29.18	36.95	27.88	18.58	7.16	23.75	28.41	12.82
1994	29.18	33.94	26.72	17.16	6.58	21.93	26.46	11.92
1995	29.18	31.22	25.68	15.87	6.06	20.28	24.58	11.12
1996	29.18	28.74	24.77	14.69	5.58	18.79	22.94	10.37
1997	29.18	26.50	23.91	13.63	5.15	17.43	21.44	9.70
1998	29.18	24.49	23.18	12.67	-0-	16.20	20.08	9.09
levelized cost over life of source	29.2	21.6	25.7	12.6	6.4	14.5	18.3	8.3

* *Figures for each option begin with the earliest date that option could begin operation.*

COST OVER LIFE OF OPTION

The estimated cost of energy from each source over the period through 1998 is shown in table 6-8. With the exception of BPA purchases, each source shows a cost declining over time due to the declining real amortization costs. BPA rates were projected on the basis of recently announced rate increase for 1982-83, 1984-85, and increases after that are predicted according to long term price projections made in May, 1981. The post-1985 projected rates are highly uncertain, and any actual differences in price above or below the projections would affect all the scenarios. BPA projects declining real rates after 1988; DNRC projected constant real rates, in order to provide a conservative estimate.

Retail power rates depend primarily on the costs of energy acquisition, distribution, and administration. DNRC projected constant real costs of administration and distribution. The WMED share of the WPPSS 4 and 5 termination costs (see chapter five, on Nuclear Power) were assumed to be paid off in 1982 and 1983; and 35 year amortization of the WMED share of the WPPSS 4 and 5 indebtedness was assumed to start in 1983. Retail rates for the five supply options are presented in table 6-9.

The pattern shown in table 6-9 is of more consequence than the specific figures. The retail estimates for any given year are close and may actually not differ, and the load projections in some cases vary less than 1 percent among the various supply options. The table demonstrates, however, that although BPA power now costs less than power from the other supply options, the cost of BPA power increases faster than the cost of power from the other sources. DNRC calculations indicate that use of the BPA option would increase the average monthly power bill by about a dollar in 1994, and slightly more thereafter.

DNRC's forecasting model was used to forecast DNRC's medium demand scenario presented in table 6-10. (DNRC projected load growth after 1998 at the rate the model predicted for growth in 1997-1998).

TABLE 6-9. RETAIL POWER RATES ASSUMED BY DNRC FOR ALTERNATE SUPPLY OPTIONS* (1981 Mills/kWh)

	BPA	Proposed Project and BPA	Dam/Conservation/Retrofit and BPA	Conservation/Retrofit and BPA	Colstrip and BPA
1982	35.32				
1983	45.12				
1984	41.06				
1985	46.15				
1986	48.47				55.67
1987	52.03				56.12
1988	51.86	62.76	52.08	52.08	54.85
1989	51.71	60.24	51.17	51.63	53.74
1990	51.58	58.12	51.39	51.35	52.81
1991	51.47	56.38	51.12	51.07	52.05
1992	51.37	54.90	50.87	50.79	51.39
1993	51.28	53.68	50.66	50.65	50.83
1994	51.21	52.64	50.48	50.37	50.36
1995	51.14	51.75	50.33	50.23	49.96
1996	51.08	51.00	50.19	50.09	49.64
1997	51.03	50.36	50.07	49.95	49.34
1998	50.98	49.81	49.98	49.95	49.12

* *Figures for each option begin with the earliest date that option could begin operation.*

TABLE 6-10. DNRC'S PROJECTION OF LOAD GROWTH IN WMED SERVICE AREA UNDER ALTERNATE SUPPLY OPTIONS

MEDIUM DEMAND SCENARIO (in average MW)*

	BPA	Proposed Project and BPA	Dam/Conservation/ Retrofit and BPA	Colstrip and BPA	Conservation/ Retrofit and BPA
80	128.6				
81	133.5				
82	136.1				
83	148.8				
84	159.1				
85	158.8				
86	160.0			153.3	
87	161.2			156.5	
88	165.4	154.0	153.7	162.0	165.1
89	169.7	160.3	160.3	167.2	169.7
90	174.1	166.7	167.0	172.4	174.3
91	172.8	172.0	172.4	176.7	178.6
92	181.8	177.5	178.1	181.4	182.4
93	185.1	181.9	182.5	185.1	185.7
94	188.6	186.4	187.2	189.1	189.5
95	192.4	191.0	191.8	193.2	193.3
96	195.8	195.1	196.0	197.0	196.8
97	199.4	199.3	200.2	200.8	200.4
98	202.8	203.2	204.3	204.5	203.9

* *Load growth is predicted for each option beginning in the earliest year that option could start operation. The load growth before the start-up of each option would be the same as under the BPA option, because all power would be furnished by BPA in that period.*

SUMMARY

On a levelized basis, power from the alternative supply options would be cheapter than from BPA under the projected BPA rates, although initially more expensive. Thus, for example, the first year cost of energy from the Proposed Project is 57.28 mills compared to a projected BPA rate in 1988 of 29.18 mills. If the proposed dam were built, the projected average 1988 cost of the 58.8 MW from the dam and the additional power required from BPA would be 39.92 mills.

The higher rates for 1988 power from the proposed project and BPA combined would lead to lower projected loads (154 average MW compared to 165 average MW) than if BPA supplied the entire amount that year at a lower cost. By 1996 the cost of energy from the proposed project would be lower than BPA wholesale rates, and by 1997 retail rates for power from the proposed project would be lower than BPA rates. After 1998, cheaper power from the proposed project would encourage higher usage than would occur if BPA were to supply all the power at a higher cost.

Although energy from Colstrip is projected to be somewhat more expensive than that from the Kootenai Falls project (25.7 mills compared to 21.64 mills on a levelized basis), it is considerably less expensive initially (40.29 mills in 1986, down to 35.81 mills by 1988). By 1992 Colstrip power is projected to be cheaper than BPA wholesale rates. Consequently the Colstrip option results in lower retail rates and higher loads than the Kootenai Falls option over the forecast period. If the forecast were carried out over a longer period this situation would reverse, because power from the proposed project would be cheaper than Colstrip power after 2001. By that year Kootenai Falls energy would cost 19.43 mills, compared to 20.08 mills for Colstrip.

The Dam/Conservation/Retrofit option relies on Kootenai Falls power along with power provided by residential conservation and dam retrofits. In the medium demand scenario, power from this option is cheaper than any except from Colstrip by the end of the forecast period. In the long run the Dam/Conservation/Retrofit option would show the lowest retail rates and consequent highest loads of the five supply options.

Although the Dam/Conservation/Retrofit option uses the lowest levelized cost resources, it has higher costs initially than either the BPA or Colstrip option.

As shown in table 6-9 the retail prices for electricity from any of the supply options increase at different rates over time. The price of power from each resource is predicted to decrease at some periods during the forecast period, but by different amounts and in different years. This variation makes the prices hard to compare. There are also different load patterns over time associated with each supply option, so DNRC used the concepts of consumers' surplus and net present value to compare the alternatives (see the following section). Furthermore, the levelized costs used in examining the Dam/Conservation/Retrofit option considered only internal costs borne by WMED exclusive of external or environmental benefits and costs, which must be considered in any comprehensive comparison of alternatives. DNRC did this in its cost benefit analysis, in the next section.

COST-BENEFIT ANALYSIS

Definitions

In discussing cost-benefit analysis, it is necessary to use some economic terms that are not in common use with the public. These terms are defined as follows.

Present value is the value today or in any given year of a series of future payments, such as the income produced by sale of power from a generating facility. Future payments are discounted to reflect the idea that society at any given time values a dollar that would be received next year less than one received today. This concept is reflected in the payment of interest on savings accounts.

Discount rate is the factor used to adjust future values to their present value. The discount rate is a measure of how much less payments next year are worth today. The *real discount rate* is the discount rate adjusted for the rate of inflation.

Net benefits of a project are determined by subtracting the project costs from the benefits. If the costs exceed the benefits the difference is called *net cost.*

Internal costs are project costs that must be borne by its owners. If dollar values can be assigned to these costs, then they are added to the price of the output from a project. An example of an internal cost is the turbines in the Kootenai Falls dam, whose costs are part of the cost per kilowatt hour that will be paid by the utility customers.

Internal benefits are benefits received by the owners of a project. An example of an internal benefit of the Kootenai Falls dam is the value of the electricity that would be produced.

External costs are project related costs borne not by the project owners but by others or by the environment. An example of an external cost associated with building the Kootenai Falls dam is the loss of the falls in its present undeveloped state.

External benefits are the counterpart of external costs. An example of an external benefit of the Kootenai Falls dam would be the picnic area improvements proposed by the applicant as part of the project.

Monetary costs are project related costs that can be quantified in dollars. Many costs, such as worker salaries or benefits, or a given amount of electricity, have a market value, and their dollar value is easily estimated. The monetary value of other costs and benefits can be estimated using techniques developed by economists. Both internal and external costs can be monetary. An example of a monetary cost associated with the Kootenai Falls dam is the cost of turbines that would be used in the dam.

Monetary benefits are the counterpart of monetary costs. An example of a monetary benefit is the value of the electricity that would be generated by the project.

Nonmonetary costs are project-related costs that have no market value, and which cannot be expressed in dollars. Both internal and external costs can be nonmonetary. An example of a nonmonetary cost associated with the Kootenai Falls dam is the aesthetic impact of dewatering the channel downstream from the dam.

Nonmonetary benefits are the counterpart of nonmonetary costs. An example of a nonmonetary benefit would be the increased control the applicant would have over its power supply if the dam were built.

Consumers' surplus is a measure of value that reflects the difference between what consumers are willing to pay for a product and what they actually pay.

Purpose of Cost-Benefit Analysis

Cost-benefit analysis is a method of comparing the costs and benefits of a project, and comparing a proposed project with alternative proposals. It is used to help determine if the economic welfare of society would be increased or decreased as a result of building a project. It is also used in making decisions about whether society would be better off building an alternative rather than the proposed project. Cost-benefit analysis can aid in making public decisions because it views costs and benefits from the perspective of society rather than from that of a project developer, as done by WMED (HARZA 1980, Chen 1982). If a cost benefit analysis is to present a true picture, it must consider all costs and benefits to society. However, it is impossible to assign dollar values to some costs and benefits, so there must be a comparison between monetary values and nonmonetary values.

This cost-benefit analysis provides a framework for making these comparisons in order to show how the costs and benefits of the proposed project compare to the costs and benefits of alternatives to the project. The analysis also identifies the factors that could cause this ranking to change.

The result of a cost-benefit analysis sometimes is expressed as a benefit-cost (B/C) ratio—for example, 1 to 1, meaning the benefits are equal to the costs. But such ratios can be misleading. For example, a project with a B/C ratio of 2 to 1 could have benefits of $200,000, and costs of $100,000, for a net benefit of $100,000, while a larger project with a ratio of 1.5 to 1 could have benefits of $1.5 million and costs of $1 million, for a net benefit of $500,000. Thus, society would be better off selecting the project with the lower B/C ratio because of its greater net benefits. Furthermore, impacts that cannot be expressed in dollars cannot be incorporated into a B/C ratio analysis. Finally, the results of a B/C ratio can change significantly depending on how certain costs and benefits are defined. For example, recreational losses, when expressed in monetary terms, can be treated either as "negative benefits" or as costs, and the B/C ratio of a project will change accordingly. For these reasons, DNRC did not use B/C ratios.

Limitations of Cost-Benefit Analysis

Cost-benefit analyses are based on assumptions about future events and their accuracy depends on the accuracy of those assumptions. These analyses assume that society's preferences in the future will be the same as they are today. However, when calculating the present value of the benefits and costs of a project, it is assumed that the benefits and costs would be worth less in the future than they are in the present, which ignores the value of these impacts on future generations.

Cost-benefit analysis does not address the question of equity. Collectively, society may be better or worse off if a project is built, but the issue of who benefits and who pays is not addressed in the analysis.

The most serious limitation of cost-benefit analysis results from the problem of how to compare benefits and costs that can be measured in dollars with those that cannot. For example, how does the loss of trout fisheries compare with the value of electricity generated from a dam?

Normally, dollar values are used for comparing costs and benefits, but it is difficult to determine the monetary value of certain costs and benefits when there is no market for them. Further, there is great variation in how the costs and benefits are valued by different individuals and groups, increasing the difficulty of making a statement about societal impact. Economists have developed methods to place monetary values on certain impacts, and these methods have some merit in decision making. The magnitude of an impact must be determined before a monetary value can be assigned. Assigning dollar values to impacts, if done cautiously, can help put the value of external costs in perspective so they can be compared to the internal monetary benefits of a project.

The most common misuse of cost-benefit analysis is to consider only monetary benefits and costs and ignore the nonmonetary impacts of a project. Although there is no easy way to integrate monetary and nonmonetary impacts, both must be considered when making a decision concerning society's welfare.

DNRC'S COST-BENEFIT ANALYSIS FOR THE PROPOSED PROJECT

DNRC limited its cost benefit analysis to the effects the proposed project would have in Montana. It is possible that the most beneficial method of providing power to the WMED service area or to Montana in general might not be the most beneficial to the Pacific Northwest or the nation as a whole. Nevertheless, the Board of Natural Resources and Conservation is responsible for ensuring that the facility represents the minimum adverse environmental impacts, considering the state of available technology and the nature and economics of the various alternatives.

Most of the impacts of building the Kootenai Falls dam would occur within Montana. Kootenai Falls is near the border of Montana and has national scenic importance, so some of the costs identified in chapter four would be felt beyond the state border. These costs were scaled back for use in determining the costs to Montana alone. On the other hand, the benefits would be somewhat greater if the analysis were done from a national perspective, because inexpensive power from the dam is more valuable when compared to the relatively higher costs of power elsewhere in the United States.

DNRC analyzed the benefits and costs to Montana of five alternative supply options identified earlier in this chapter.

To determine the relative merit of each supply option, the changes to Montana that would result from each option are measured by comparison with a "business as usual" alternative, referred to as the base-case. For the purposes of this analysis, the BPA supply option is the base case and represents the historical practice of WMED in obtaining all its power from BPA.

This analysis separates the costs and benefits into two major categories, internal and external. These two categories will be further divided into monetary and nonmonetary components.

Internal Benefits and Costs

By definition, the internal benefits and costs of any of the supply options would accrue to the members of WMED. Only the internal benefits and costs in excess of those that would result from the BPA supply option are considered.

Calculation of Internal Monetary Net Benefits

The internal monetary benefit of each supply option is the benefit that the WMED customers would receive if that option would allow them to purchase power more cheaply than it could be purchased under the BPA supply option. Monetary net benefits of an option are calculated by multiplying the price difference between the BPA supply option and the particular option being compared by the average yearly electrical load. The total annual dollar savings are then discounted over the 50-year life of the Kootenai Falls project to determine the present value of the internal monetary net benefits. An example of the calculation is given in table 6-11, and actually measures the change in what economists call "consumers' surplus." Initially, power under the BPA supply option would be less expensive than power from any of the other options considered so there would be an internal monetary net cost to the WMED customers.

The monetary cost of each supply option is included in the price the customer must pay for the electricity. Price and consumption estimates come from the retail rates and load growth forecasts made in the Supply Demand Integration section.

Assumptions used in the internal monetary net benefit calculations are as follows.

1. For each resource option, DNRC's medium demand scenario is used to predict prices and loads up to 1998 and loads are forecast to grow at the 1997-1998 growth rate throughout the remainder of the projected life of the Kootenai Falls dam (Nordell 1982c).
2. All prices for each supply option are a weighted average of the price of power from each individual supply source in that option (i.e., under the Proposed Project supply option, the price would represent the weighted average of 58 average MW from Kootenai Falls and the additional power that would be required from BPA) (see Supply Demand Integration). The price includes the cost of energy, distribution, administration, and payback of the completed portion of the WPPSS plants (Nordell 1982c).

3. The difference between the amount of power available from any option and the projected load is met by purchasing power from the BPA.
4. It is assumed the supply options are independent.
5. Implementation of a particular supply option is the only change from the base case, i.e., real prices of other goods and services, consumer preferences, population, and income distribution are assumed to remain the same.
6. The entire WMED service area is assumed to be in Montana because the only available load projections are for the entire service area. However, between 85 and 90 percent of the WMED load is in Montana.
7. The internal monetary net benefit of each supply option is calculated to the year 2038, corresponding to the assumed 50-year life of the Kootenai Falls dam if it were to become operational in 1988. The Colstrip plants are assumed to become operational in 1986 and have a useful life of 37 years, after which their share of the load would be met by purchase from BPA. All interim power would be purchased from BPA.
8. All values are calculated in 1981 dollars.
9. A real discount rate of 4.31 percent is used (see DNRC Cost Estimation Method in chapter five).

Results

Table 6-12 presents the estimated internal monetary net benefits for each supply option, discounted to 1983, the first year any costs would be incurred for the Kootenai Falls dam. A real discount rate of 4.31 percent is used. Based on internal monetary net benefits only, the Dam/Conservation/Retrofit supply option would have the greatest net benefits, followed by the Proposed Project option, Colstrip, the Conservation/Retrofit option, and the BPA option.

TABLE 6-11. INTERNAL MONETARY BENEFITS OF THE PROPOSED PROJECT

Calculation for 1998

Price of power under the proposed project option	(table 6-9)	49.81 mills/kWh	($.04981)
Price of power under BPA supply option	(table 6-9)	50.98 mills/kWh	($.05098)
Load projected under the proposed project option	(table 6-10)	203.2 Avg. MW	
Load projected under the BPA option	(table 6-10)	202.8 Avg. MW	
Number of kWh per year per Avg. MW		8,760,000	

Computation for 1998:

$$(\$.05098 - \$.04981) \times \left(\frac{203.2 + 202.8}{2}\right) \times 8{,}760{,}000 = \$2{,}080{,}588$$

$$\text{Discounting to 1983: } \$2{,}080{,}588 \times \frac{1}{1.0431^{16}} = \$1{,}059{,}183$$

TABLE 6-12. PRESENT VALUE OF INTERNAL MONETARY NET BENEFITS TO MONTANA FOR EACH SUPPLY OPTION (1981 dollars)

Supply Option	Internal Monetary Net Benefits Millions of Dollars
Dam/Conservation/Retrofit*	$83.7
Proposed Project*	46.7
Colstrip	37.8
Conservation/Retrofit	27.9
BPA**	-0-

* *The internal monetary net benefits of the proposed project and the Dam/Conservation/Retrofit options may be overstated because the possible Canadian diversion in 2024 (see Water Rights section, chapter four) is not included, some of the benefits may accrue to non-Montanans, and sedimentation may stop operation in less than 50 years.*

** *The analysis measures deviations from the base case (the BPA supply option), so this value is zero.*

Sensitivity

The internal net monetary benefits from each option are sensitive to two major factors. The first is the uncertainty about future prices of BPA power. The price of BPA power would affect the ranking in two ways. First, BPA power would be purchased under any of the supply options, because no single option can meet all projected needs. Second, each supply option is compared to the BPA supply option when calculating net benefits.

The second factor affecting sensitivity is the use of different discount rates to calculate the net present value of internal monetary net benefits. A higher discount rate places a lower value on future benefits and a higher value on benefits that occur in the near rather than distant future, whereas a lower discount rate places a relatively higher value on benefits in the distant rather than near future. The results of using different discount rates are shown in table 6-13. DNRC regards the 4.31-percent real discount rate as reasonable (see chapter five for a discussion of how this rate was derived). The other results are shown to illustrate that changing the value placed on the future can change the results of the analysis.

Internal Nonmonetary Benefits

If the Kootenai Falls dam were built, the members of WMED would benefit by reducing their dependence on BPA as a supplier of electricty. This benefit would have two major components. The cooperative members would have more control over their rates and be less susceptible to BPA rate fluctuations over which they have no control. WMED also would be less vulnerable to BPA curtailment policies, should they be invoked. Conservation and the dam retrofits would provide these benefits, but to a much lesser extent. Purchasing a share of Colstrip would give WMED some control over its share of the output, but the degree of control would be less than that of Kootenai Falls because other parties own a larger share of the Colstrip plants.

External Benefits and Costs

The WMED decision to apply to build the Kootenai Falls dam is based on the internal costs and benefits that would accrue to it. External costs and benefits—impacts and advantages that accrue to others or to the environment—would not necessarily enter into the WMED decision. However, these costs

TABLE 6-13. RANKING OF SUPPLY OPTIONS BASED ON INTERNAL MONETARY NET BENEFITS USING DIFFERENT DISCOUNT RATES

Discount Rate (Percent)	3	4.31	6	8	10	12
Ranking:*						
1	Dam/Conservation/Retrofit	Dam/Conservation/Retrofit	Dam/Conservation/Retrofit	Dam/Conservation/Retrofit	Conservation/Retrofit	Conservation/Retrofit
2	Proposed Project	Proposed Project	Colstrip	Conservation/Retrofit	Colstrip	BPA
3	Colstrip	Colstrip	Conservation/Retrofit	Colstrip	BPA	Colstrip
4	Conservation/Retrofit	Conservation/Retrofit	Proposed Project	BPA	Dam/Conservation/Retrofit	Dam/Conservation/Retrofit
5	BPA	BPA	BPA	Proposed Project	Proposed Project	Proposed Project

** 1 = highest internal monetary net benefits; 5 = lowest.*

and benefits, both monetary and nonmonetary, must be considered by DNRC under MFSA. As with the internal benefits and costs, only the external benefits and costs in excess of the BPA supply option are considered.

External Benefits

DNRC estimated the external benefits of taxes and labor, which, from the perspective of society, are adjustments to the costs of the project.

Labor. From the perspective of society, the cost of building a project is reduced if laborers that would otherwise be unemployed are used to construct the project. Wages paid for such workers are costs to the owner, but not to society. Lincoln County has high levels of unemployment and a number of experienced dam workers that were employed on Libby Dam. To assess the effects the Kootenai Falls project would have on these workers, DNRC calculated the probability that unemployed workers in the county or elsewhere in Montana would be hired (Davis, A. 1982) using methods developed by Haveman and Krutilla (1968). The percentage of unemployed Montana workers hired on the dam was estimated to be 13.7 percent of the work force. This figure was applied to the total yearly work force and multiplied by the average wage rate to determine the amount of the benefit (Davis, A. 1982). Employment value was calculated for each of the five years it would take to complete the dam and discounted using a real discount rate of 4.31 percent. The resulting value is $1.9 million which should be added to the monetary net benefits of the Proposed Project supply option and the Dam/Conservation/Retrofit option. No data were available to make these same computations for the Colstrip and Conservation/Retrofit supply options, but patterns of unemployment among properly trained workers in counties where these projects are or would be are not the same as for potential dam workers in Lincoln County.

Taxes. From the perspective of society, the power cost estimate used in calculating internal monetary net benefits overstated the cost of the dam to Montana because it included the taxes paid on the dam. For the purpose of cost benefit analysis, taxes are considered transfer payments that have a neutral effect on society since one group incurs the costs while another reaps the benefits. This perspective obviously ignores the equity consequences of taxation. In the case of Kootenai Falls, the Montana customers in the WMED service area pay the cost of taxes in their electric bills, while the residents of Lincoln County, including those of Libby and Troy, which are not served by WMED, reap most of the tax benefits.

To properly adjust the costs of the dam to a societal perspective, the actual cost used in the price computations for the forecast and net benefits calculations should be reduced by the value of these tax payments. As with the labor adjustment, the value of taxes paid can be added as a monetary net benefit. Assuming a 50-year dam life, a constant real level of payments over the life of the project, and a 4.31-percent real discount rate, the net present value of tax payments for the Kootenai Falls dam is $21.0 million in 1981 dollars (Davis, A. 1982). Using the same assumptions (except assuming a 37-year life) for the Colstrip supply option, the net monetary benefits of taxes paid on the WMED share of Colstrip would be $13.9 million (Davis, A. 1982). The value of the taxes on the dam retrofits using the same assumptions as the Kootenai Falls calculation would be $4.0 million. The $21.0 million should be added to the net present value of the Proposed Project and the Dam/Conservation/Retrofit supply options, and the $13.9 million should be added to the net present value of the Colstrip option. The $4.0 million should be added to the Conservation/Retrofit and the Dam/Conservation/Retrofit options. The total to be added to the Dam/Conservation/Retrofit option is $25.0 million.

External Costs

Although most external costs cannot be valued in monetary terms, DNRC made monetary estimates for one external cost, the value of the recreational resource that would be lost if the Kootenai Falls dam were built. Other external costs that cannot be quantified are described following the Recreation section below.

Recreation Loss. Duffield (1981) estimated the net annual loss to Montana of current recreational uses of the Kootenai Falls area should the Kootenai Falls dam be built. The estimates of net recreational loss were based upon total visitor use of the falls (including non-Montanans) so the value of the net recreational loss was scaled back to address only the use by Montanans.

Several methods were used to calculate the net recreational loss which resulted in a range of estimates. The total impact of these annual values is calculated over the 5-year construction period and the assumed 50-year life of the dam. The annual values are assumed to grow at the same rate as inflation, which means the estimate each year remains constant when valued in 1981 dollars. This understates the future value that would result if use in the future were to increase. The values are discounted using a real discount rate of 4.31 percent to be consistent with the rest of the cost-benefit analysis, and are shown in table 6-14.

TABLE 6-14. ESTIMATED VALUE OF RECREATIONAL LOSS TO MONTANA IF THE KOOTENAI FALLS DAM WERE BUILT (1981 dollars)

(assuming 50-year life and 4.31 percent real discount rate)

Method of Estimation	Millions of Dollars
Compensation	$47.0
Willingness-to-Pay	3.4
Travel Costs	2.1
Daily Entrance Fee	.6

These values are actually estimates of external monetary net costs associated with building the dam at Kootenai Falls and should be subtracted from the monetary net benefits (table 6-12) of the Proposed Project supply option and the Dam/Conservation/Retrofit option. There are no recreational adjustments to be made for the Colstrip and Conservation/Retrofit option.

Other External Costs

A cost-benefit analysis is not complete unless it considers all costs and benefits. Table 6-15 shows a general picture of those environmental effects to which no monetary values have been or can be assigned.

Table 6-16 shows ways in which these environmental "costs" could be reduced. The tables summarize the detailed impact discussions from chapter four.

As in the case of the assessment of monetary benefits, there are uncertainties inherent in the summaries contained in tables 6-15 and 6-16 and chapter four.

For example, there are differences in the precision with which the actual magnitude and likelihood of each impact to each resource can be predicted. The type and extent of vegetation that would be inundated by the reservoir is known more or less precisely, but the number of fish that would be killed in passing through the turbines is estimated with less precision.

TABLE 6-15. SUMMARY OF LONG-TERM ENVIRONMENTAL IMPACTS*

Category of Concern	Impact	Magnitude of Effect
Fishery**	Decline in high quality fishery through decreased movement of fish and aquatic invertebrates downstream, reduced water velocity and sedimentation, the prevention of upstream movement of fish, turbine mortality to fish, loss of the falls as a source of oxygen to reduce deficiency caused by Libby Dam, replacement of "blue ribbon" trout stream segment with reservoir fish habitat.	Highly adverse
Wildlife**	Decline of wildlife and and habitat diversity, through loss of riparian vegetation, loss of the harlequin duck population, probable losses to mountain sheep from effects on the Corps replacement habitat.	Highly adverse to adverse, although new reservoir habitat could benefit some aquatic mammals

TABLE 6-15. (CONTINUED)

Recreation and Aesthetics	Loss of recreation and aesthetic resources through inundation of China Rapids, dewatering of falls and canyon, placement of a concrete and steel structure in an otherwise natural scene, decline in fishing, loss of opportunity to view harlequin ducks and possible decrease in opportunities to see mountain sheep.	Highly adverse
History and Archaeology	Cumulative loss through construction, inundation vandalism, and theft (impacts of Libby Dam and the proposed Kootenai Falls and re-regulating dams) of historical and archaeological materials and sites that could be essential to defining the history and prehistory of the Kootenai valley.	Highly adverse
Kutenai Indians	Loss of sacred area, and of sources of food that have cultural or religious significance.	Highly adverse
Water Quality	Loss of water oxygenation provided by the falls causing reduction in the number of stoneflies, an important trout food species, below the falls.	Adverse
Visitor Safety	Safety hazard from wadeability of the partially dewatered reach, combined with the possible malfunction in the powerhouse (predicted to happen once a year) leading to sudden major increases in water level in the dewatered area.	Adverse

* *Long-term is defined as extending past the construction period. Only the most significant impacts are included in the table. As a result, few beneficial environmental impacts are listed because most are minor.*

** *In most instances, these impacts could not be reduced in the sense that the effects on specific resources in certain places could be softened. That is to say, for example, that little or nothing can be done to prevent loss of trout stream habitat in the reservoir, although it might be possible to create or enhance a trout fishery within reach of the people that now fish above the falls, thus somewhat easing the lost opportunities to fish for trout.*

TABLE 6-16. POSSIBLE METHODS OF REDUCING IMPACTS

	Method	Resource Affected	Amout of Impact + Reduction	Cost Effec-tiveness + + +
1	Construction of dam at Kootenai Falls with a reservoir elevation of 1,990 ft, rather than 2,000 ft	Wildlife, fishery recreation and aesthetics, history and archaeology	Low to moderate	Low*
2	Maintenance of minimum flow of 4,000 cfs over the falls, except during emergencies when flow may be reduced to 2,000 (this would be consistent with the agreement on releases from Libby Dam)	Wildlife, fishery recreation and aesthetics, history and archaeology	Low to moderate	Low*
3	Combination of the two above	Same as above	Moderate	Low*
4	Allow the entire river flow over the falls at night during the two month downstream migration season, preferably in combination with (3) above	Fishery	Moderate	Low*
5	Improve spawning conditions in tributaries downstream from the dam	Fishery	Moderate**	Possibly high
6	Build and operate an artificial spawning channel downstream from the dam	Fishery	Unknown**	Unknown
7	Plant trout from suitable brood stock	Fishery	Low	Unknown

TABLE 6-16. (CONTINUED)

8	Improvement of fisherman access downstream from the dam	Fishery/ recreation	Low to moderate**	Possibly high
9	Purchase of trout water elsewhere with permanent protection from development	Fishery	Moderate**	Unknown
10	Procurement of flow reservations in Kootenai River tributaries	Fishery	Unknown**	Unknown
11	Design turbines to improve fish survival	Fishery	Unknown	Unknown
12	Purchase and improve land elsewhere to replace lost habitat	Wildlife	High**	Unknown
13	Post bond to ensure proper reclamation	Wildlife	Moderate	High
14	Same as above	Wildlife (waterfowl)	High	High
15	Excavation of some affected prehistoric campsites + +	Archaeology	Low	Unknown

+ *Pertains to long-term impacts only.*

* *Costs from these measures would result primarily from lost generating capacity and/or shortened lifespan of the project.*

** *These measures would reduce the impacts to a given resource in a given area, for example by improving fishery quality elsewhere in the Kootenai, but would have no effect on the impacts that would result from the dam.*

+ + *Excavation of prehistoric sites would not reduce the impact to the Kutenai Indians who do not want the sites disturbed.*

+ + + *A cost effectiveness rating of "low" means that relatively little would be gained for the money spent.*

SUMMARY OF ENVIRONMENTAL IMPACTS OF ALTERNATE SUPPLY OPTIONS

rvation/Retrofits

ierization restricts air movement in and out
es, which can contribute to indoor air pollu-
s problem can be alleviated by taking steps
ntain adequate air interchange when
izing.

arn retrofits would entail placement of tur-
existing dams. There will be some en-
ntal impacts, largely downstream sedimen-
luring construction, and fish mortality caus-
e turbines. The long-term impacts should be
normal river flow patterns were not affected
chaeological site, a prehistoric campsite,
e inundated when the retrofit resulted in a
crease in the Broadwater Dam reservoir.

environmental impacts associated with the
pply option are the impacts to Montana that
ccur if BPA were to contract for new addi-
eneration facilities to meet that portion of
load that would otherwise have been met by
osed facility. DNRC believes other existing
ed sources could meet these future loads
t there would not be any additional en-
ntal impacts to Montana associated with
ply option.

onservation/Retrofit

environmental impacts associated with the
nservation/Retrofit option are the sum of all
vidual impacts associated with the proposed
the dam retrofits, and conservation, as
ed individually above.

ip

nvironmental impacts of the Colstrip supply
are difficult to determine. The impacts
ted with building and operating Colstrip

Units 3 and 4 will occur whether the members of WMED purchase a share or not. It can be argued that, as with the BPA supply option, the environmental impacts associated with the Colstrip option are the ones that would occur in Montana if WMED's purchase of a 7 percent share (73.5 MW) were to require the members of the Colstrip consortium to build or purchase a share of new facilities. In other words, other customers will demand another 73.5 MW from the consortium members. Seventy percent of the Colstrip output is owned by utilities operating outside of Montana, so 70 percent of the 73.5 MW share would be met by new facilities outside Montana, and would cause no environmental impact in Montana. Thus, the environmental impacts that might result in Montana from the Colstrip supply option would be those impacts associated with the 30 percent (22 MW) of the 73.5 MW that would belong to Montana Power.

The next major facilities scheduled for construction by Montana Power are a dam at Carter's Ferry on the Missouri River and a coal-fired plant near Great Falls. If the schedule of these proposed facilities were to be accelerated as a result of Montana Power needing the 22 MW or if selling 22 MW to WMED were to force Montana Power to build these facilities, then the environmental impacts from the new facilities would result in part from WMED's purchase of the Colstrip power. If the 22 MW is met by conservation, on the other hand, there would be almost no environmental impacts in Montana as a result of the purchase.

Differential Comparison of Nonmonetary Costs and Benefits of Supply Options

The major nonmonetary costs and benefits to Montana of the five supply options are compared in table 6-17. Each option is compared to the BPA option.

TABLE 6-17. COMPARISONS OF MAJOR NONMONETARY EFFECTS OF ALTERNATE SUPPLY OPTIONS

Nonmonetary Costs*	Proposed Project	Dam/Conservation/Retrofit	Conservation/ Retrofit	Colstrip
Fisheries	Substantially Worse	Substantially Worse	Neutral	Neutral
Bighorn Sheep Habitat	Substantially Worse	Substantially Worse	Neutral	Neutral
Aesthetics	Substantially Worse	Substantially Worse	Neutral	Neutral
Archaeological and Historical Sites	Substantially Worse	Substantially Worse	Worse	Neutral
Religious freedom of Kutenai Indians	Substantially Worse	Substantially Worse	Neutral	Neutral

* *The effects of each option are stated in comparison to the effects of the BPA option*

Conclusions

As stated in the introduction to the cost-benefit analysis, this analysis only provides a framework method for comparing a proposed project with alternatives to that project. The decision on which alternative is the best is not easy to make.

Table 6-18 summarizes the cost-benefit section. The table is a balance sheet. The benefits of each supply option listed on one side can be compared to the adverse effects on the other side. Although all impacts must be considered when evaluating the project, only the major nonmonetary impacts are listed in the table. DNRC defines impacts as major if they are sufficient to alter the relative ranking of the supply options.

Table 6-18 compares nonmonetary benefits and costs of the alternative supply options. The supply option in which the benefits surpass the costs by the greatest amount is the best option. Implementation of a supply option with higher costs than benefits would reduce Montana's welfare.

There are no major nonmonetary benefits associated with any option in table 6-18, so any option that has a net monetary cost is dropped from further consideration.

The most difficult portion of this analysis is the comparison of monetary benefits and nonmonetary adverse effects. In order to make this comparison, the relative importance of the nonmonetary impacts must be estimated. DNRC has already done preliminary weighting by identifying the impacts of major importance. However, such weighting is not possible in some cases. For example, the impacts to the Kutenai Indians appear to be to their civil rights and religious freedom, which cannot be assigned a relative value.

As with the comparison of monetary costs and benefits, only the options with higher benefits than costs should be compared in the final analysis. This final analysis is the determination of which of the remaining alternatives has the greatest benefit to Montana. If no option yields greater benefits than the BPA option, then BPA is the best choice. It is the role of the Board to assign the weights to the nonmonetary impacts, and to decide which is the best supply option for Montana, primarily on the basis of information contained in this document.

SUMMARY OF ENVIRONMENTAL IMPACTS OF ALTERNATE SUPPLY OPTIONS

Conservation/Retrofits

Weatherization restricts air movement in and out of houses, which can contribute to indoor air pollution. This problem can be alleviated by taking steps to maintain adequate air interchange when weatherizing.

The dam retrofits would entail placement of turbines in existing dams. There will be some environmental impacts, largely downstream sedimentation, during construction, and fish mortality caused by the turbines. The long-term impacts should be small if normal river flow patterns were not affected. One archaeological site, a prehistoric campsite, would be inundated when the retrofit resulted in a 1.6 ft increase in the Broadwater Dam reservoir.

BPA

The environmental impacts associated with the BPA supply option are the impacts to Montana that would occur if BPA were to contract for new additional generation facilities to meet that portion of WMED load that would otherwise have been met by the proposed facility. DNRC believes other existing or planned sources could meet these future loads and that there would not be any additional environmental impacts to Montana associated with this supply option.

Dam/Conservation/Retrofit

The environmental impacts associated with the Dam/Conservation/Retrofit option are the sum of all the individual impacts associated with the proposed project, the dam retrofits, and conservation, as discussed individually above.

Colstrip

The environmental impacts of the Colstrip supply option are difficult to determine. The impacts associated with building and operating Colstrip Units 3 and 4 will occur whether the members of WMED purchase a share or not. It can be argued that, as with the BPA supply option, the environmental impacts associated with the Colstrip option are the ones that would occur in Montana if WMED's purchase of a 7 percent share (73.5 MW) were to require the members of the Colstrip consortium to build or purchase a share of new facilities. In other words, other customers will demand another 73.5 MW from the consortium members. Seventy percent of the Colstrip output is owned by utilities operating outside of Montana, so 70 percent of the 73.5 MW share would be met by new facilities outside Montana, and would cause no environmental impact in Montana. Thus, the environmental impacts that might result in Montana from the Colstrip supply option would be those impacts associated with the 30 percent (22 MW) of the 73.5 MW that would belong to Montana Power.

The next major facilities scheduled for construction by Montana Power are a dam at Carter's Ferry on the Missouri River and a coal-fired plant near Great Falls. If the schedule of these proposed facilities were to be accelerated as a result of Montana Power needing the 22 MW or if selling 22 MW to WMED were to force Montana Power to build these facilities, then the environmental impacts from the new facilities would result in part from WMED's purchase of the Colstrip power. If the 22 MW is met by conservation, on the other hand, there would be almost no environmental impacts in Montana as a result of the purchase.

Differential Comparison of Nonmonetary Costs and Benefits of Supply Options

The major nonmonetary costs and benefits to Montana of the five supply options are compared in table 6-17. Each option is compared to the BPA option.

TABLE 6-17. COMPARISONS OF MAJOR NONMONETARY EFFECTS OF ALTERNATE SUPPLY OPTIONS

Nonmonetary Costs*	Proposed Project	Dam/Conservation/Retrofit	Conservation/ Retrofit	Colstrip
Fisheries	Substantially Worse	Substantially Worse	Neutral	Neutral
Bighorn Sheep Habitat	Substantially Worse	Substantially Worse	Neutral	Neutral
Aesthetics	Substantially Worse	Substantially Worse	Neutral	Neutral
Archaeological and Historical Sites	Substantially Worse	Substantially Worse	Worse	Neutral
Religious freedom of Kutenai Indians	Substantially Worse	Substantially Worse	Neutral	Neutral

* *The effects of each option are stated in comparison to the effects of the BPA option*

Conclusions

As stated in the introduction to the cost-benefit analysis, this analysis only provides a framework method for comparing a proposed project with alternatives to that project. The decision on which alternative is the best is not easy to make.

Table 6-18 summarizes the cost-benefit section. The table is a balance sheet. The benefits of each supply option listed on one side can be compared to the adverse effects on the other side. Although all impacts must be considered when evaluating the project, only the major nonmonetary impacts are listed in the table. DNRC defines impacts as major if they are sufficient to alter the relative ranking of the supply options.

Table 6-18 compares nonmonetary benefits and costs of the alternative supply options. The supply option in which the benefits surpass the costs by the greatest amount is the best option. Implementation of a supply option with higher costs than benefits would reduce Montana's welfare.

There are no major nonmonetary benefits associated with any option in table 6-18, so any option that has a net monetary cost is dropped from further consideration.

The most difficult portion of this analysis is the comparison of monetary benefits and nonmonetary adverse effects. In order to make this comparison, the relative importance of the nonmonetary impacts must be estimated. DNRC has already done preliminary weighting by identifying the impacts of major importance. However, such weighting is not possible in some cases. For example, the impacts to the Kutenai Indians appear to be to their civil rights and religious freedom, which cannot be assigned a relative value.

As with the comparison of monetary costs and benefits, only the options with higher benefits than costs should be compared in the final analysis. This final analysis is the determination of which of the remaining alternatives has the greatest benefit to Montana. If no option yields greater benefits than the BPA option, then BPA is the best choice. It is the role of the Board to assign the weights to the nonmonetary impacts, and to decide which is the best supply option for Montana, primarily on the basis of information contained in this document.

TABLE 6-18. COST-BENEFIT SUMMARY

(millions of 1981 dollars)

Benefits	Costs
PROPOSED PROJECT	
Monetary - $69.6*	Monetary - $0.6 -$47.0** Nonmonetary - Major Adverse Impacts to: Fisheries Bighorn Sheep Habitat Aesthetics Archaeological and Historical Sites Religious Freedom of Kutenai Indians
DAM/CONSERVATION/RETROFIT	
Monetary -$110.6	Monetary -$ 0.6 -$47.0 Nonmonetary -same as proposed project
CONSERVATION/RETROFIT Monetary - $31.9	No Major Impacts
COLSTRIP	
Monetary - $51.7	No Major Impacts

* *Monetary benefits include price benefits to the consumer and adjustments to taxes and labor costs.*

** *The range in dollar figures shows the present value at Kootenai Falls as estimated by various methods.*

CHAPTER SEVEN - OPTIONS AND DECISIONS

This draft EIS provides information regarding the environmental impacts and economics of the proposed project and alternatives to it. These analyses are based on technical reports that DNRC developed from its studies of the project. The technical reports are available from DNRC upon request. On the basis of information in this EIS and comments received in response to it, along with any new information from other sources, DNRC will prepare its final EIS recommending whether the Board of Natural Resources and Conservation should grant or deny the certificate necessary for construction of the proposed project.

The project has been proposed by Western Montana Energy Developers (WMED), a consortium of seven electric cooperatives and one federal irrigation project, to serve the predicted growth in their electric load. One of these electric cooperatives, Northern Lights, Inc., serves loads in Montana, Idaho and Washington. The other members of WMED serve loads located only in Montana. About 26.5 percent of the output of the proposed facility would go to Northern Lights, Inc. and half of that would serve Northern Lights' Montana customers. None of the cooperatives owns any electric generation facilities and their loads (total 116 MW in 1981) are supplied almost entirely by BPA.

The impetus for construction of the proposed facility came in 1976 when BPA announced that after 1983 it would no longer serve the full requirements of its preference customers. This situation was reversed by enactment of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 under which BPA is required to negotiate full requirements contracts with its preference customers, which include the cooperatives. Nevertheless, construction of the proposed hydroelectric project would still provide relatively inexpensive electricity and a measure of energy security to WMED.

The proposed project would provide only 18 percent of WMED's original forecast load of 324 average MW by 1998, [or 23 percent of its most recent revised load estimate of 255 MW for that year]. The balance of the load would have to be served by other supply sources, probably BPA. DNRC forecasts a lower load growth, reaching a total load of 203 average MW during the same period, but agrees with the applicant that additional energy will be required in the future. This conclusion does not necessarily mean that the proposed dam is required, but indicates that an additional supply of electricity would be needed.

The Board, pursuant to the Siting Act, may not grant a certificate unless it finds "that the facility represents the minimum adverse environmental impact, considering the state of available technology and the nature and economics of various alternatives," and that it serves the "public interest, convenience and necessity." If there is a supply option that would result in less environmental impact than the proposed facility, then the Board may rule that the proposed facility is not required. The difficulty lies in determining whether another supply option has a less adverse impact than the proposed option. As the draft EIS explains, there are slightly more expensive options that would have fewer and less severe impacts to the physical and human environment than the proposed dam. The cost-benefit analysis provides the framework to compare the various options to one another in economic terms, but it does not resolve the problem of which option has the least adverse impact. In evaluating the relative severity of impacts from the various options, the Board must compare the monetary and nonmonetary benefits as outlined in chapters five and six against monetary and nonmonetary costs including the environmental impacts as outlined in chapter four and summarized in chapter six. This is a difficult determination because it depends upon the exercise of judgment and the application of subjective values.

This draft EIS and the subsequent final EIS are intended to provide sufficient information to make an informed decision, but cannot be expected to resolve the uncertainties connected with the proposed hydroelectric project at Kootenai Falls as discussed in this EIS.

After considering all the pertinent issues, the Board must choose one of the following options:

1) approve the project as proposed

2) approve the project as applied for with whatever conditions may be necessary to avoid or reduce environmental impacts

3) reject the project on the grounds that it cannot meet the need for electricity with the least environmental impact.

APPENDIX A

**Advisory
Council On
Historic
Preservation**

1522 K Street, NW
Washington, DC 20005

JUL 1[illegible] RECD

JUL 10 1981

Mr. Thomas E. DeWitt
Office of Electric Power Regulation
Federal Energy Regulatory Commission
825 North Capitol Street
Washington, D.C. 20246

Dear Mr. DeWitt:

On May 15, 1980, our Western Division of Project Review in Denver wrote to you regarding the Draft Environmental Impact Statement (DEIS) for the Kootenai River Hydroelectric Project No. 2752, in Montana. At that time we pointed out that the DEIS showed no evidence of compliance with Section 106 of the National Historic Preservation Act, or with the Council's regulations (36 CFR Part 800) implementing Section 106.

On April 10, 1981, we received the Final Environmental Impact Statement (FEIS) for the same project, and were sorry to see that our efforts to alert you to a critical legal deficiency in the DEIS had gone unnoticed; the FEIS still showed no evidence of attention to the requirements of Section 106 or the Council's regulations. On May 13, having reviewed the FEIS, we advised you of its deficiency.

We have now been advised that FERC has scheduled the project for hearings before an Administrative Law Judge, and that FERC will not consider attending to its responsibilities under Section 106 unless the Council formally intervenes in the proceeding.

Section 106 places an affirmative responsibility on every "independent agency having authority to license any undertaking" to "take into account the effect of the undertaking on any (property) included in or eligible for inclusion in the National Register (of Historic Places)" and "afford the Advisory Council on Historic Preservation...a reasonable opportunity to comment with regard to such undertaking." Section 211 of the same Act authorizes Council rulemaking with respect to Section 106. 36 CFR Part 800 establishes the procedures for obtaining Council comment and ensuring that effects have been taken into account.

We are advised that, to date, FERC has not even determined whether properties eligible for inclusion in the National Register are subject to effect by the Kootenai River Project, although a number of prehistoric and historic archeological sites are known in the vicinity, and local Native American groups have vigorously asserted that the area is of great cultural importance to them as the site of vision quests fundamental to the practice of their religion. We are further advised that ethnographic and archeolgical data exist that support this contention.

Before reaching a conclusion regarding issuance of a permit for the Kootenai River Hydroelectric Project, FERC should consult the Montana State Historic Preservation Officer and the Secretary of the Interior to determine whether historic or cultural properties subject to effect are eligible for the National Register. If eligible properties are discovered, FERC should obtain the comments of the Council in accordance with 36 CFR Part 800 before reaching its decision about the project.

Sincerely,

Robert Garvey

Robert R. Garvey, Jr.
Executive Director

APPENDIX B

WATER USE PERMIT CRITERIA

Applications

Before DNRC can issue a water use permit, the applicant must by law (Section 85-2-311, MCA) prove by substantial credible evidence that five criteria are met:

1) There are unappropriated waters in the source of supply, at times when the water can be put to the use proposed by the applicant; in the amount the applicant seeks to appropriate; and throughout the period during which the applicant seeks to appropriate, the amount requested is available

2) The rights of a prior appropriator will not be adversely affected

3) The proposed means of diversion, construction, and operation of the appropriation works are adequate

4) The proposed use of water is a beneficial use

5) The proposed use will not interfere unreasonably with other planned uses or developments for which a permit has been issued or for which water has been reserved.

There is a sixth criterion that must be met for withdrawals such as proposed by the applicant:

6) An applicant for an appropriation of 10,000 acre-feet a year or more and 15 cubic feet per second or more proves by clear and convincing evidence that the rights of a prior appropriator will not be adversely affected.

The above six criteria include the 1981 legislative changes. (Legally,"clear and convincing" evidence is held more persuasive than the"substantial credible" criterion that applies to 1 through 5 above.)

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